MEC*check*™ Software User's Guide

1992, 1993, and 1995 Model Energy Code
Version 3.0
April 2000

MEC*check*™ was developed by the Building Energy Standards Program at Pacific Northwest National Laboratory for use by the U.S. Department of Housing and Urban Development (HUD) and the Rural Economic and Community Development (RECD) under contract with the U.S. Department of Energy's Office of Codes and Standards. Pacific Northwest National Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

We encourage any questions, comments, or suggestions you may have regarding the MEC*check* materials.
Contact information:

DOE's Building Standards and Guidelines Program
Energy Codes Hotline: 1-800-270-CODE (2633)
Internet Address: www.energycodes.org
Technical Support: TechSupport@bsgp.pnl.gov

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ACKNOWLEDGMENT

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Introduction to MEC*check*

What are the MEC and IECC?

The Model Energy Code (MEC) contains energy-related building requirements applying to many new U.S. residences. The MEC was previously maintained by the Council of American Building Officials (CABO), which was comprised of the three U.S. model code groups: the Building Officials and Code Administrators, International (BOCA); the International Conference of Building Officials (ICBO); and the Southern Building Code Congress International (SBCCI). These groups subsequently combined into an "umbrella" organization called the International Code Council (ICC). The ICC issued the 1998 MEC under a new name, the 1998 International Energy Conservation Code (IECC).

Both the MEC and the IECC codes contain energy-related requirements applying to many new U.S. residences. The U.S. Department of Housing and Urban Development (HUD) loan guarantee program requires compliance with the MEC. The Rural Economic and Community Development (RECD, fomerly the Farmer's Home Administration) loan guarantee program requires that single-family buildings comply with the MEC. Several states have also adopted the MEC or IECC as their residential energy code.

The MEC and IECC codes specify thermal envelope requirements for one- and two-family residential buildings and multifamily residential buildings three stories or less in height. A major focus of the code provisions is on the building envelope insulation and window requirements, which are more stringent in colder climates. Maximum U-factor requirements are specified for walls, ceilings, floors, crawl space walls, and basement walls and minimum R-value requirements are specified for slab floors. To comply with the code, a building must be constructed with components meeting or exceeding these requirements. However, the U-factor of a given assembly may be increased or the R-value of a given assembly may be decreased, provided the total heat gain or loss for the entire building does not exceed the total resulting from conformance with the requirements. Other requirements focus on the heating and cooling system (including ducts), water-heating systems, and air leakage.

What Buildings Must Comply?

The code applies to new residential buildings, three stories or less in height, and additions to such buildings. Residential buildings are defined as detached one- and two-family buildings (referred to as single-family buildings or type A1 in the code) and multifamily buildings (such as apartments, condominiums, townhouses, dormitories, and rowhouses). Multifamily buildings have three or more attached dwelling units and are referred to as

type A2 in the code. Throughout these materials, generic references to "building(s)" signify residential buildings three stories or less in height.

When over 10% of the area of any floor of a residential building is used for commercial purposes, the portion of the building used for commercial purposes must meet the requirements of the commercial energy code. In such cases, the code will only apply to those portions of the building that are used for residential purposes. Multifamily buildings four or more stories above grade are considered commercial buildings.

Exemptions

The following building categories are exempted from the provisions of the code:

- existing buildings
- very low-energy buildings (<3.4 Btu/h· ft2 or 1 W/ft2 of floor area)
- buildings (or portions of buildings) that are neither heated nor cooled
- buildings designated as historical.

About the MEC*check* Materials

The MEC*check* materials are applicable to the 1992, 1993, and 1995 MEC and the 1998 and 2000 IECC, and refer to these codes collectively as the code. The MEC*check* software has a *Code* menu which allows you to select the code for which compliance is to be determined. Two sets of printed MEC*check* materials are available; one set for the three MEC code editions and a second set for the two IECC code editions. Although these codes are quite similar, there are some differences in the code requirements that occasionally must be reflected in the text of the materials. When a block of text or a table only applies to a certain edition of the code, the applicable year is printed in the margin to the left of the text or table.

The MEC*check* materials provide guidance on how to meet the code requirements. Making the MEC and IECC simple and understandable was the major motivation for developing them. The desire for simplicity and clarity led to changes in format, deletion of redundant text, and deletion of text that had no impact. If you are familiar with the MEC and/or IECC, you will note that the MEC*check* materials differ significantly in format from these codes.

The MEC*check* materials were created for HUD and RECD. Check with your building department or other state or local building code enforcement authority to verify that the MEC*check* materials are accepted in your jurisdiction, because some of the requirements may be superseded by state laws or local ordinances.

It is not necessary to have a copy of the code to use any MEC*check* materials. Although the *Basic Requirements Guide* lists code section numbers for cross reference, it is not necessary to refer to the referenced sections. All references to figures and tables in a specific guide refer to figures and tables located in that guide unless specifically stated otherwise.

What's in the MEC*check* Guides?

The *Basic Requirements Guide* applies to all residential buildings and should be read by all users of MEC*check* materials. Home builders and designers can then use one of the three MEC*check* approaches to show compliance with the insulation and window requirements. The prescriptive package approach is described in the *Prescriptive*

Package User's Guide. The software approach is described in the *Software User's Guide*. The trade-off approach is described in *the Trade-Off Worksheet User's Guide*. The MEC*check Workbook* is a collection of guides which includes the *Basic Requirements Guide*, the *Prescriptive Package User's Guide*, the *Trade-Off Worksheet User's Guide*, and the *Software User's Guide*, with the software diskette attached to the last page.

The *Basic Requirements Guide* discusses all of the basic requirements except for the insulation and window requirements (which are covered in other sections). The basic requirements represent minimum criteria that must be met regardless of which insulation compliance approach you choose. These criteria include provisions that limit air leakage through the building envelope and regulate heating and cooling systems and duct insulation levels.

The *Prescriptive Package User's Guide* describes the simplest of the three compliance approaches. With this approach, you select a package of insulation and window requirements from a list of packages developed for a specific climate zone. Each package specifies insulation levels, glazing areas, glazing U-factors, and sometimes heating and cooling equipment efficiency. Once selected, simply meet or exceed all requirements listed in the package to achieve compliance. Few calculations are required.

The *Trade-Off Worksheet User's Guide* briefly describes a "pencil-and-paper" compliance approach. The trade-off approach enables you to trade off insulation and window efficiency levels in different parts of the building. You can trade off ceiling, wall, floor, basement wall, slab-edge, and crawl space wall insulation; glazing and door areas; and glazing and door U-factors. The trade-off approach calculates whether your home as a whole meets the overall code insulation and window requirements.

The *Software User's Guide* explains how to use the MEC*check* software approach. The software approach is the most flexible of the three compliance approaches. The software allows trade-offs between all building envelope components and heating and cooling equipment efficiencies. With minimal input, you can quickly compare different insulation levels to select a package that works best for your proposed building. Unlike the prescriptive package and trade-off approaches, the software approach enables you to trade off basement wall, slab-edge, and crawl space wall insulation depth as well as insulation R-value. The software automatically generates a report that can be submitted for plan review to document compliance.

Several forms, worksheets, and lists are included with the MEC*check* materials to help determine and document compliance. You may make multiple copies of the forms and distribute them freely. Alternative forms that provide the same information may also be used if they are approved by your jurisdiction.

Who Should Use the MEC*check* Materials?

The MEC*check* materials were designed to guide builders and designers, plan check personnel, and field inspectors through the code compliance process. All necessary compliance forms, reference materials, and explanations are included.

Builders and Designers can follow each step of the compliance process presented in the MEC*check* guides. The *Basic Requirements Guide* describes code requirements that must be satisfied by all residences. The *Prescriptive Package User's Guide*, the *Software User's Guide*, and the *Trade-Off Worksheet User's Guide* offer a choice of approaches, any of which can be used to show compliance with the insulation and window requirements of the code.

Plan Check Personnel can use the *Plan Check and Field Inspection Guide* as a guide to ensure that building plans and specifications comply with the code. If questions arise, the

plan reviewer can trace the compliance steps used by the applicant and reference the steps in the other guides.

Field Inspectors and Site Superintendents can use *the Plan Check and Field Inspection Guide* to ensure that all of the applicable code requirements have been installed in a building. The features that meet these requirements must be included on the building plans or specifications and on compliance forms. The *Basic Requirements Guide* will also be of interest to field inspectors and site superintendents. It describes the features that must be installed in the building regardless of the compliance approach chosen.

MEC*check* Compliance Process?

Figure 1 illustrates the steps you should follow to determine compliance with the code.

Step 1: Determine If Your Building Must Comply with the Code. (See What Buildings Must Comply? in this introduction.)

Step 2: Meet the Basic Requirements. The basic requirements discussed in the *Basic Requirements Guide* must be incorporated into the design.

Step 3: Use One of Three Compliance Approaches for Insulation and Windows. Select one of the three compliance approaches described in the *Prescriptive Package User's Guide*, *the Software User's Guide*, and the *Trade-Off Worksheet User's Guide*. Examining the prescriptive packages for the building location will give you an idea of the insulation requirements. Use the selected approach to determine the insulation and window requirements. Document compliance on the form(s) provided for the selected approach.

Step 4: Submit Building Plans and Compliance Forms for Plan Review. Submit MEC*check* forms or their equivalent, building plans, and specifications for plan review. The compliance forms must match the building plans and specifications.

Step 5: Construct the Building According to Approved Plans. In most jurisdictions, construction may begin after a building permit is issued. It is required to have the approved set of plans and specifications at the job site for use by the field inspector. MEC*check* forms or their equivalent must be re-submitted if changes from the approved plans or specifications are made that increase the glazing area, decrease insulation R-values, or decrease equipment efficiencies of the building.

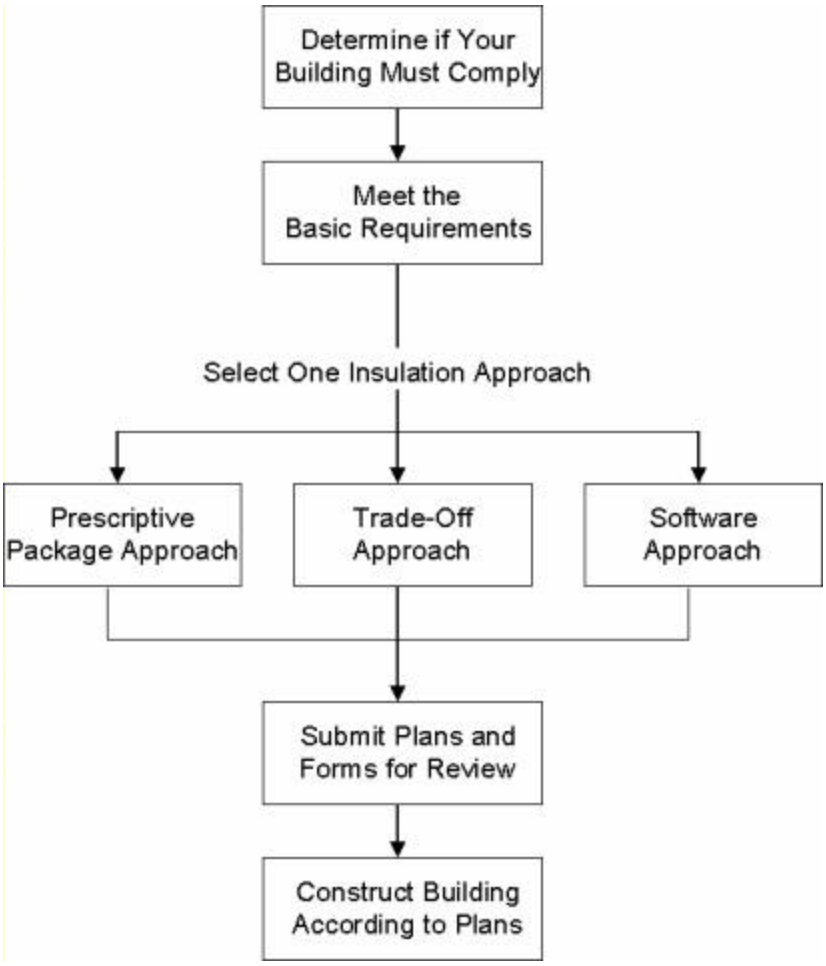


Figure 1. MECcheck Compliance Path

Basic Requirements Guide

1992 MEC, 1993 MEC, and 1995 MEC

Inside This Guide

Basic Requirements

The code specifies basic requirements that are mandatory for all buildings. Some of these requirements apply to the heating and cooling system (including ducts), hot water system, and electrical system. Other requirements apply to material and equipment identification and to sealing the building envelope. This guide discusses the code basic requirements, except for the insulation and window requirements (which are covered in other guides). Each requirement in this guide lists the corresponding code section number as a reference.

Figure 1 graphically illustrates several basic requirements. Refer to the *Summary of Basic Requirements* provided with this guide for a one-page listing of the requirements discussed below.

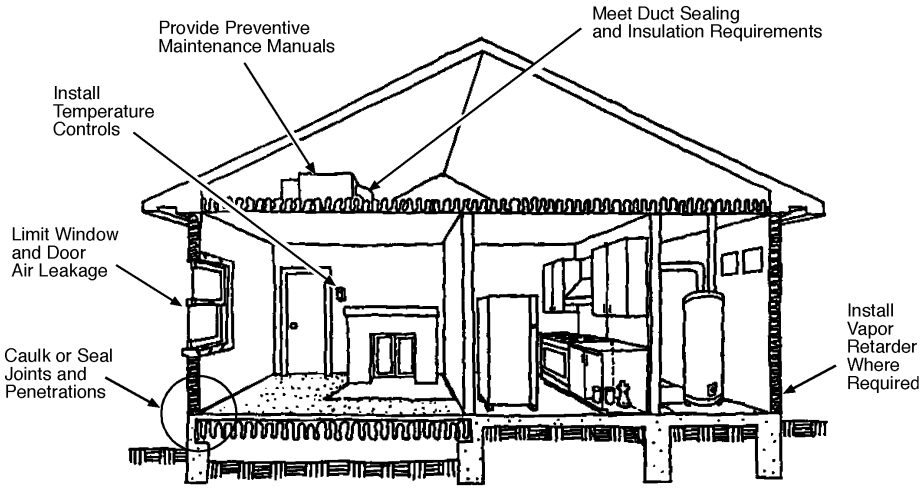


Figure 1. Some of the Basic Requirements

Air Leakage

(1992: Section 502.4.3; 1993: Section 502.3.3; 1995: Sections 502.3.3 and 502.3.4) All joints and penetrations in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed in an approved manner. The following areas should be sealed using appropriate materials :

- exterior joints around window and door frames

- between wall sole plates, floors, and exterior wall panels

- openings for plumbing, electricity, refrigerant, and gas lines in exterior walls, floors, and roofs

- openings in the attic floor (such as where ceiling panels meet interior and exterior walls and masonry fireplaces)
- service and access doors or hatches
- openings for plumbing and gas lines in the subfloor and interior plates of kitchens and bathrooms
- all other similar openings in the building envelope

1995

- recessed lighting fixtures.

Sealants used between dissimilar materials (such as between the sole plate and a slab floor) must allow for the expansion and contraction of the materials.

1995 Recessed lighting fixtures must be 1) IC rated with no penetrations, or 2) IC rated in accordance with ASTM 283, or 3) installed inside an air-tight assembly with a 0.5 inch (12.76 mm) clearance from any combustible material and a 3 inch (76 mm) clearance from insulation material.

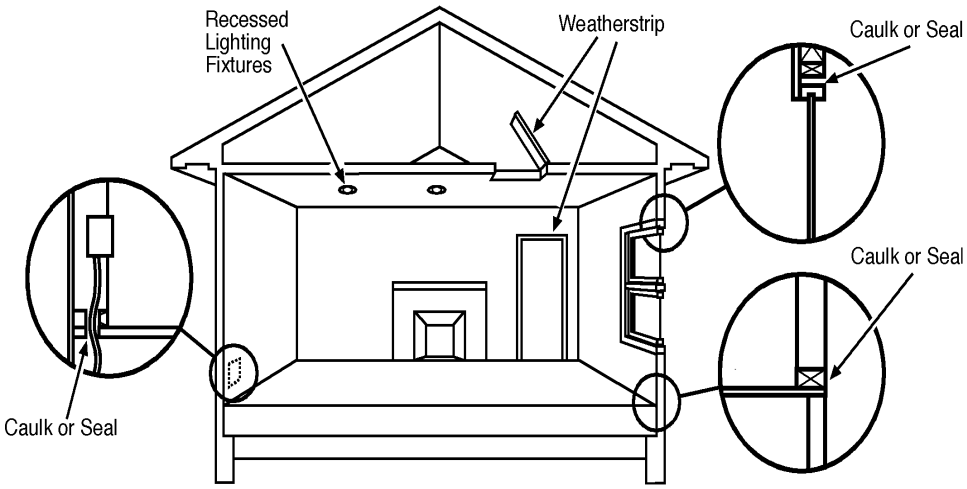


Figure 2. Typical Openings that Should be Sealed

Vapor Retarders

(Section 501.1.4) Vapor retarders must be installed in all non-vented framed ceilings, walls, and floors. Non-vented areas are framed cavities without vents or other openings allowing the free movement of air. The vapor retarder must have a perm rating of 1.0 or less and must be installed on the "warm-in-winter side" of the insulation (between the insulation and the conditioned space).

Exemptions: Vapor retarders are not required:

- In the climate zones identified in Table 1. Exempted climate zones are also identified with an "(H)" in the state county listing in Appendix E and on the state maps included with the prescriptive packages. If you are using the MEC*check* software, the vapor retarder requirement is printed in the *Inspection Checklist*. If the requirement is not printed in the checklist, the building's location is exempt.
- Where moisture or its freezing will not damage the materials.

Table 1. Vapor Retarder Requirement Exemptions

State(s)	Zones
Texas	2-5
Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina	4-6
Arkansas, Tennessee	6-7
Florida, Hawaii, Louisiana, Mississippi	All

Materials and Equipment Information

(Section 104.2) Insulation R-values and glazing and door U-factors must be clearly marked on the building plans or specifications. If two or more different insulation levels exist for the same component, record each level separately on the plans or specifications. For example, if the walls adjacent to the garage have less insulation than the other walls, both insulation levels must be noted. If credit is taken for high-efficiency heating or

cooling equipment, the equipment efficiency, make and model number must also be marked on the plans or specifications.

(Section 102.1) Materials and equipment must be identified in a manner that will allow compliance with the code to be determined. There are several ways to label materials and equipment to satisfy this requirement.

- Provide labels on all pertinent materials and equipment. For example, the R-value of the insulation is often pre-printed directly on the insulation or can be determined from a striping code. Window U-factors are often included on the manufacturer label posted directly on the window.
- Provide contractor statements certifying the products they have installed. For example, the insulation contractor should certify the R-value of the installed insulation.
- An optional *Energy Label* is included in Appendix D. Materials and equipment can be identified on this label which should then be posted in the residence (e.g., on the main fuse box, on a garage wall, in the utility room) to document the energy efficiency features of the building.

1995 *(1995: Section 102.1.3)* For blown or sprayed insulation, the initial installed thickness, the settled thickness, the coverage area, and the number of bags must be clearly posted at the job site. In attics, thickness markers must be placed at least once every 300 square feet.

(Section 102.2) Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided to the homeowner.

Heating and Cooling

Heating and Cooling Equipment Efficiencies

The code defines heating and cooling equipment efficiency requirements. However, federal regulations have restricted manufactured equipment efficiency minimums to levels at or above these code requirements. Because new equipment efficiencies below the code requirements can no longer be manufactured, these requirements have been omitted from the MEC*check* materials.

Duct Insulation

(1992 and 1993: Section 503.9.1; 1995: Section 503.7.1) Supply- and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces (spaces neither heated nor cooled) must be insulated to the minimum R-value specified in Table 2. Unconditioned spaces include ventilated crawl spaces, ventilated attics, and framed cavities in those floor, wall, and ceiling assemblies which a) separate conditioned space from unconditioned space or outside air and b) are uninsulated on the side facing away from conditioned space.

Exceptions: Duct insulation is not required in the following cases:

- within heating, ventilating, and air conditioning (HVAC) equipment
- for exhaust air ducts
- when the design temperature difference between the air in the duct and the surrounding air is 15°F or less.

Additional insulation with vapor barrier must be provided if condensation will create a problem.

Select the zone number for your building location and find the R-value requirement from Table 2 based on where the ducts are located. For the prescriptive package and trade-off worksheet approaches, your zone number can be found in Appendix E or on the state map included with the prescriptive packages. If you are using the MEC*check* software, the duct insulation requirement is printed in the *Inspection Checklist*.

When ducts are located in exterior building cavities, either

- The full insulation R-value requirement for that building component must be installed between the duct and the building exterior, in which case the ducts do not require insulation, or
- The ducts must be insulated to the duct R-value requirement given in Table 2 and the duct area must be treated as a separate component. For example, if ducts insulated to R-6 are located in an exterior wall insulated to R-19, the area of the wall minus the duct area is a wall component with R-19 insulation, and the area of the ducts is a wall component with R-6 insulation.

1992

Table 2. Duct Insulation R-Value Requirement for 1992 MEC

Zone Number	Ducts Located in Attics, Crawl Spaces, Exterior Cavities, Outside	Ducts Located in Unheated Basements
Zones 1-8	R-6	R-6
Zones 9-16	R-8	R-6
Zone 17	R-9	R-6
Zone 18	R-9	R-8
Zone 19	R-11	R-8

1993 1995

Table 2. Duct Insulation R-Value Requirements for 1993 and 1995 MEC

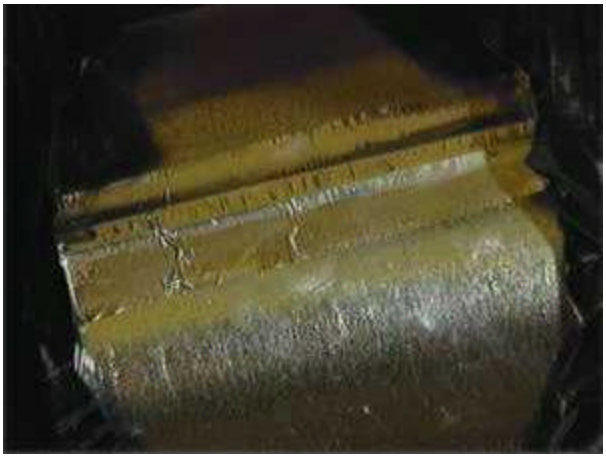
Zone Number	Ducts in Unconditioned Spaces (i.e. Attics, Crawl Spaces, Unheated Basements and Garages, and Exterior Cavities)	Ducts Outside the Building
Zones 1-4	R-5	R-8
Zones 5-14	R-5	R-6.5
Zones 15-19	R-5	R-8

Duct Construction

1992 1993 *(Section 503.10.2)* All transverse joints in ductwork located in unconditioned spaces must be sealed with mastic, tape, or mastic plus tape. Pressure-sensitive tape may be used for fiberglass ductwork.

1995 *(Section 503.8.2)* Ducts must be sealed using mastic with fibrous backing tape. For fibrous ducts, pressure-sensitive may be used. Other sealants may be approved by the building official. Duct tape is not permitted.

Duct with mastic



(1992 and 1993: Section 503.6; 1995: Section 503.5) The HVAC system must provide a means for balancing air and water systems. For air systems, this requirement can be met by installing manual dampers at each branch of the ductwork or by installing adjustable

registers that can constrict the airflow into a room. For water systems, balancing valves can be installed to control the water flow to rooms or zones.

Temperature Controls

(1992 and 1993: Section 503.8.3.1; 1995: Section 503.6.3.1) For one- and two-family buildings, at least one thermostat must be provided for each separate system (heating, cooling, or combination of heating and cooling). Electric baseboard heaters can be individually controlled by separate thermostats or several baseboard heaters can be controlled by a single thermostat.

(1992 and 1993: Section 503.8.3.2; 1995: Section 503.6.3.2) For multifamily buildings, each dwelling unit must have a separate thermostat and a readily accessible, manual or automatic means to restrict or shut off the heating and/or cooling input to each room must be provided. Operable diffusers or registers that can restrict or shut off the airflow into a room meet this requirement.

(1992 and 1993: Section 503.8.3.3; 1995: Section 503.6.3.2) At least one thermostat must be provided for each system or each zone in the non-dwelling portions of multifamily buildings. For example, separate systems serving interior corridors or attached laundry rooms must have their own thermostat.

(1992 and 1993: Section 503.8; 1995: Section 503.6.1) Each heating and cooling system must have a thermostat with at least the following range:

- Heating only (55°F to 75°F)
- Cooling only (70°F to 85°F)
- Heating and cooling (55°F to 85°F) – the thermostat must be capable of operating the system heating and cooling in sequence (i.e., simultaneous operation is not permitted).

Thermostat

Heat Pump Thermostats

(1992 and 1993: Section 503.4.2.3; 1995: Section 503.3.2.23) Heat pump installations must include a thermostat that can prevent the back-up heat from turning on when the

heating requirements can be met by the heat pump alone. A two-stage thermostat that controls the back-up heat on its second stage meets this requirement.

HVAC Piping Insulation

(1992 and 1993: Section 503.11; 1995: Section 503.9) All HVAC piping (such as in hydronic heating systems) installed in unconditioned spaces and conveying fluids at temperatures greater than 120°F or chilled fluids at less than 55°F must be insulated to the thicknesses specified in Table 3. Pipe insulation is not required for piping installed within HVAC equipment.

Table 3. Minimum HVAC Piping Insulation Thickness [a]

Piping System Types	Fluid Temp Range (°F)	Insulation Thickness in Inches by Pipe Sizes [b]			
		Runouts 2in. [c]	1 in. and less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55 Below 40	0.5 1.0	0.5 1.0	0.75 1.5	1.0 1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

New Minimum Thickness = 4.6 x Table 2-3 Thickness/Actual R-Value

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

New Minimum Thickness = 4.0 x Table 2-3 Thickness/Actual R-Value

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.

(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Service (Potable) Water Heating

Swimming Pools

(Section 504.5) All heated swimming pools must be equipped with an on/off pool heater switch mounted for easy access. Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources (such as solar heat).

(Section 504.5.3) All swimming pool pumps must be equipped with a time clock.

Circulating Service Hot Water Systems

(Section 504.6) Circulating hot water systems must have automatic or manual controls that allow the pumps to be conveniently turned off when the hot water system is not in operation.

(Section 504.7) Piping in circulating hot water systems must be insulated to the levels specified in Table 4 unless an engineering calculation is provided that demonstrates that insulation will not reduce the annual energy requirements of the building.

Table 4. Minimum Insulation Thickness for Recirculation Piping

Heated Water Temperature (°F)	Insulation Thickness in Inches by Pipe Sizes (a)			
	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5-2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0
(a) Nominal pipe size and insulation thickness.				

Electrical

(1992 and 1993: Section 505.2; 1995: Section 505.1) All dwelling units in multifamily buildings must be equipped with separate electric meters.

1992 Model Energy Code
Summary of Basic Requirements

Air Leakage	• Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed.
Vapor Retarder	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials. • Texas — Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina — Zones 4-6 • Arkansas, Tennessee — Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi — All Zones
Materials and Insulation Information	• Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
Duct Insulation	Supply and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces must be insulated to the levels shown on the reverse side of this sheet. *Exceptions:* Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is 15EF or less.
Duct Construction	• All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	• Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: Heating Only — 55EF - 75EF Cooling Only — 70EF - 85EF Heating and Cooling — 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
HVAC Piping Insulation	HVAC piping in unconditioned spaces conveying fluids at temperatures above 120EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.
Swimming Pools	• All heated swimming pools must have an on/off pool heater switch. • Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources. • All swimming pool pumps must be equipped with a time clock.
Circulating Hot Water	• Circulating hot water systems must have automatic or manual controls. • Pipes must be insulated to the levels shown on the reverse side of this sheet.
Electric Systems	Each multifamily dwelling unit must be equipped with separate electric meters.

Version 3.0/April 2000/U.S. Department of Housing and Urban Development / Rural Economic and Community Development/U.S. Dept. of Energy/Pacific Northwest National Laboratory

Duct Insulation R-Value Requirements

Zone Number	Duct Insulation R-Value Requirements	
	Ducts Located In: Attics, Crawl Spaces, Exterior Cavities, Outside	Ducts Located In: Unheated Basements
Zones 1-8	R-6	R-6
Zones 9-16	R-8	R-6
Zone 17	R-9	R-6
Zone 18	R-9	R-8
Zone 19	R-11	R-8

Minimum HVAC Piping Insulation Thickness[(a)]

Piping System Types	Fluid Temp Range (EF)	Insulation Thickness in Inches by Pipe Sizes[(b)]			
		Runouts 2 in.[(c)]	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\textit{New Minimum Thickness} = \frac{4.6 \times \textit{Table 2\&2 Thickness}}{\textit{Actual R\&Value}}$$

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

$$\textit{New Minimum Thickness} = \frac{4.0 \times \textit{Table 2\&2 Thickness}}{\textit{Actual R\&Value}}$$

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.
(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Minimum Insulation Thickness for Recirculation Piping

Heated Water Temperature (EF)	Insulation Thickness in Inches by Pipe Sizes[(a)]			
	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5 - 2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

1993 Model Energy Code
Summary of Basic Requirements

Air Leakage	• Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed.
Vapor Retarder	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials. • Texas — Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina — Zones 4-6 • Arkansas, Tennessee — Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi — All Zones
Materials and Insulation Information	• Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
Duct Insulation	Supply and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces must be insulated to the levels shown on the reverse side of this sheet. *Exceptions:* Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is 15EF or less.
Duct Construction	• All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	• Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: Heating Only — 55EF - 75EF Cooling Only — 70EF - 85EF Heating and Cooling — 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
HVAC Piping Insulation	HVAC piping in unconditioned spaces conveying fluids at temperatures above 120EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.
Swimming Pools	• All heated swimming pools must have an on/off pool heater switch. • Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources. • All swimming pool pumps must be equipped with a time clock.
Circulating Hot Water	• Circulating hot water systems must have automatic or manual controls. • Pipes must be insulated to the levels shown on the reverse side of this sheet.
Electric Systems	Each multifamily dwelling unit must be equipped with separate electric meters.

Version 3.0/April 2000/U.S. Dept. of Housing and Urban Development / Rural Economic and Community Development/U.S. Dept. of Energy/Pacific Northwest National Laboratory

1993 Model Energy Code

Duct Insulation R-Value Requirements

Zone Number	Ducts in Unconditioned Spaces (i.e. Attics, Crawl Spaces, Unheated Basements and Garages, and Exterior Cavities)	Ducts Outside the Building
Zones 1-4	R-5	R-8
Zones 5-14	R-5	R-6.5
Zone 15-19	R-5	R-8

Minimum HVAC Piping Insulation Thickness[a]

Piping System Types	Fluid Temp Range (EF)	Insulation Thickness in Inches by Pipe Sizes[b]			
		Runouts 2 in.[c]	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\textit{New Minimum Thickness} = \frac{4.6 \times \textit{Table 2\&2 Thickness}}{\textit{Actual R\&Value}}$$

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

$$\textit{New Minimum Thickness} = \frac{4.0 \times \textit{Table 2\&2 Thickness}}{\textit{Actual R\&Value}}$$

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.
(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Minimum Insulation Thickness for Recirculation Piping

Heated Water Temperature (EF)	Insulation Thickness in Inches by Pipe Sizes[a]			
	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5 - 2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

1995 Model Energy Code
Summary of Basic Requirements

Air Leakage	• Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed. • Recessed lights must be type IC rated and installed with no penetrations or installed inside an appropriate air-tight assembly with a 0.5-in. clearance from combustible materials and 3-in. clearance from insulation.
Vapor Retarder	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials. • Texas — Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina — Zones 4-6 • Arkansas, Tennessee — Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi — All Zones
Materials and Insulation Information	• Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
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Duct Construction	• All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	• Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: Heating Only — 55EF - 75EF Cooling Only — 70EF - 85EF Heating and Cooling — 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
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Version 3.0/April 2000/U.S. Dept. of Housing and Urban Development / Rural Economic and Community Development/U.S. Dept. of Energy/Pacific Northwest National Laboratory

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(a) Nominal pipe size and insulation thickness.

Software User's Guide

1992 MEC, 1993 MEC, and 1995 MEC

Inside This Guide

Software Overview

This user's guide describes how to use the MEC*check*™ Software Version 3.0. MEC*check* is designed to demonstrate compliance with the requirements of the Council of American Building Officials (CABO) Model Energy Code (MEC) and the International Code Council (ICC) International Energy Conservation Code (IECC). It is the most flexible approach for meeting the MEC insulation and window requirements (refer to the *Basic Requirements Guide* in the MEC*check Workbook* for additional requirements that must also be satisfied). The MEC*check* software runs on the Microsoft Windows operating system.

The MEC*check* software demonstrates compliance with the 1992, 1993, and 1995 editions of the MEC and the 1998 and 2000 editions of the IECC. All illustrations in this section are based on compliance with the 1995 MEC. However, compliance with the other editions is achieved similarly.

The software enables you to quickly compare different insulation levels in different parts of your building to arrive at a package that works best for you. A report that can be submitted with your building plans for plan review is automatically generated.

MEC*check* performs a simple U-factor x Area (UA) calculation for each building assembly to determine the overall UA of your building. The UA that would result from a building conforming to the code requirements is compared against the UA for your building. If the total heat loss (represented as a UA) through the envelope of your building does not exceed the total heat loss from the same building conforming to the code, then the software declares that you pass. A high-efficiency equipment trade-off can also be performed.

MEC*check* is appropriate for insulation and window trade-off calculations in residential detached one- and two-family buildings (referred to as single-family buildings) and multifamily buildings (such as apartments, condominiums, townhouses, and rowhouses). Multifamily buildings include residential buildings three stories or less in height with three or

more attached dwelling units. The MEC*check* software generates a report that lists the insulation and window levels of your proposed building, as well as the additional basic requirements found in the code. The *Basic Requirements Guide* covers these other requirements in more detail.

Getting Started

Conventions Used in This Guide

The MEC*check* software can be used to demonstrate compliance with the 1992, 1993, and 1995 editions of the MEC and the 1998 and 2000 editions of the IECC. Although these codes are quite similar, there are some differences in the code requirements that occasionally must be reflected in the text of this user's guide. When a block of text or a table only applies to a certain edition of the code, the applicable year is printed in the margin to the left of the text or table in the printed materials. Two sets of printed MEC*check* materials are available; one set for the three MEC code editions and a second set for the two IECC code editions.

1992 1993 1995 Georgia — Code years in italics indicate text is only applicable to the indicated MEC or state code edition.

ALL CAPITALS — ALL CAPITALS - File and directory names are capitalized.

Bold Italics — ***Bold Italics*** - Commands are shown in bold italics.

Bold Initial Caps — ***Bold Initial Caps*** - The keys on your keyboard, such as **Tab** and **Shift+Tab**, are shown in bold initial caps. Some keyboard short cuts require you to hold down the **Alt** key while pressing another key. For example, you press **Alt+F** to select the ***F****ile* menu. In this guide, short cuts are shown in bold type.

Italics - *Italics* - An italic typeface is used to represent text as it appears on the screen in the program.

→ — ®An arrow is used to indicate a sequence of menu and submenu selections, such as ***H****elp*→***H****elp Topics*.

What you Need to Run MEC*check*

MEC*check* requires a Windows-based computer with at least the following hardware and software:

- an 80486 processor
- 6 MB extended RAM
- a VGA or Super VGA monitor
- a Microsoft-compatible mouse.

MEC*check* is a Windows application and requires Microsoft Windows 95, 98, 2000, or NT.

Installing MEC*check*

You must install MEC*check* onto your hard disk as instructed below. Before installing the software, make sure your computer meets the minimum hardware and software requirements.

To install MEC*check* from the CD-ROM:

1. Insert the CD into the CD drive of your computer. The Installation dialogs will automatically appear.

2. Follow the instructions on the screen.

If the Installation dialogs do not appear:

1. Select the *Start* button and choose *Run* from the menu.
2. Type <source>\MECcheck\setup.exe (where <source> is the CD drive letter).
3. Click *OK* and follow the installation instructions.

Starting MEC*check*

To run the MEC*check* software after installation, select Programs from the *Start* button and select MEC*check* from the programs list. Alternatively, if you are using Windows Explorer or File Manager, you can change to the MEC*check* subdirectory and double-click on the MEC*check* icon.

Screen Layout

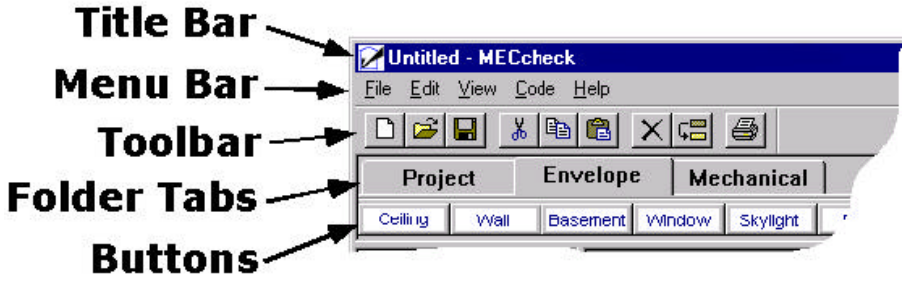
Title Bar - The title bar displays the name of the currently open project data file and the currently selected code. If no file is open, the word *Untitled* is displayed.

Menu Bar - The menu bar is located directly under the title bar and displays the available menus–***F**ile, **E**dit, **V**iew, **C**ode* and ***H**elp*. These menus are discussed in more detail in the following sections.

Toolbar - The toolbar contains buttons with images representing some of the same options available in the menus.

Folder Tabs - The *Project, Envelope, and Mechanical* folder tabs are used to choose the respective screens.

Buttons - The buttons located directly under the *Envelope* and *Mechanical* folder tabs are used to create a list of building or HVAC components.



User Prompts and Status Messages - The bottom left corner of the screen displays prompts and status messages.

Compliance Status Bar

Max. UA The *Max. UA* field displays the total UA of the code building (the house built to code requirements). To demonstrate compliance with the code, the UA of your house must be less than or equal to the UA displayed in this field.

Your UA The field labeled *Your UA* displays the UA of your proposed building based on the building components you chose and the information you supplied about each of these components. The UA displayed in this field must be less than or equal to the UA displayed in the *Max. UA* field to demonstrate compliance with the code.

% Better Than Code

MEC*check* compares the UA of your proposed house to the UA of the code house (the same house built to code requirements). This comparison is expressed as a percentage and displayed in the *% Better (Worse) Than Code* field. The percentage gives an indication of the amount by which your house exceeds or fails code requirements. A green percentage indicates that your home's heat loss is less than that of the code house. A red percentage indicates that your home's heat loss exceeds that of the code house.

Text Colors Used in the Software

Colors Used In Table Fields

Black on white text indicates the data is editable by the user.

Black on gray text indicates the data was calculated by the program and is not directly editable by the user.

Dark blue on white text indicates the data was selected from a drop down list. Clicking on such fields with the left mouse will re-display the appropriate list.

Red on white text indicates data is either missing or not within a valid range.

Colors Used In Compliance Fields

Red on white compliance results indicates the design does not comply.

Green on white compliance results indicates the design complies.

Table Columns and Rows

The *Envelope* and *Mechanical* screens have grid-like tables used to enter and store data. The rows and columns in the tables can be deleted, moved, collapsed and expanded.

Rows

Selecting Rows - To select a row, click on the tree label corresponding to that row or click on the leftmost column of that row (the column containing row numbers). The row will be reversed (black background) when correctly selected. You can also select multiple rows by holding down the left mouse button on the left-hand column and dragging it over the desired rows.

Moving Rows - Rows can be moved by:

1. selecting the row(s) to be moved (as described above),
2. releasing the mouse button,
3. clicking the mouse button on the leftmost column of any of the selected rows (a small box will appear at the tail end of the arrow cursor),
4. dragging the mouse to the new location – a thin red line will appear indicating where the row(s) should be placed,
5. releasing the mouse button when the red line has been placed in the desired location.

 Arrow cursor when dragging rows or columns.

A single table row can also be moved by dragging the corresponding row label in the tree located to the left of the table. Click the mouse on the desired label and drag it to another label on the tree. After releasing the mouse, the dragged label (and row) will be positioned directly under the label on which it was dropped. Some restrictions apply to the placement of rows. In the *Envelope* screen, for example, window and door rows can only be placed under above-grade wall or basement wall rows. Skylight rows can only be placed under ceiling rows.

Collapsing and Expanding Rows - On the *Envelope* screen, rows can also be collapsed and expanded by using the tree located to the left of the table. Rows that fall below a "parent" row on the tree can be collapsed so they are not displayed. For example, an exterior wall row with several windows and doors under it can be collapsed to hide the windows and doors. A tree label with a minus sign to the left of the label is already expanded. It can be collapsed by clicking on the box containing the minus sign. Tree labels that are already collapsed have a plus sign to the left of the label. They can be expanded by clicking the box containing the plus sign. Clicking the plus or minus sign to the left of the *Building* label will expand or collapse all rows in the table.

Deleting Rows – Rows can be deleted by selecting the row or rows to be deleted and selecting ***D**elete Row(s)* from the ***E**dit* menu or selecting the delete rows icon from the toolbar.

Multiple consecutive rows can be selected by holding down the left mouse button on the left-hand column and dragging it over the desired rows. Non-consecutive rows can be selected by holding down the **Ctrl** key while clicking on the leftmost column of each row to be selected.

In the *Envelope* screen, if you delete a wall or basement row with windows or doors linked to it, the windows and doors will also be deleted. Likewise, deleting a ceiling row with a skylight linked to it will cause the skylight to be deleted as well.

Duplicating Rows – Rows can be duplicated by selecting the row or rows to be duplicated and selecting *Duplicate Row(s)* from the ***E**dit* menu or selecting the duplicate rows icon from the toolbar.

Multiple rows can be duplicated, but they must be consecutive.

Columns

Selecting Columns - Select a single column by clicking the left mouse button on the column heading. Select multiple columns by pressing the left mouse button and dragging it over the desired column headings. Selected columns will be reversed (black background).

Moving Columns - Columns can be moved by:

1. selecting the column(s) to be moved (as described above),
2. releasing the mouse button,
3. clicking the mouse button on the column heading of any of the selected columns (a small box will appear at the tail end of the arrow cursor),
4. dragging the mouse to the new location-a thin red line will appear indicating where the column(s) should be placed,
5. releasing the mouse button when the red line has been placed in the desired location.

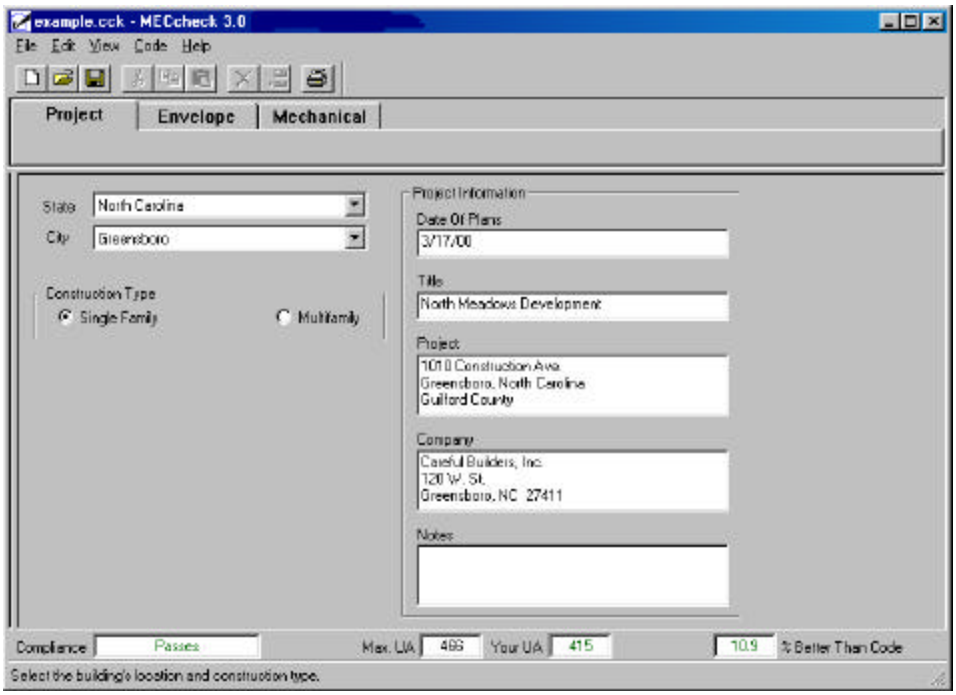
Changing Column Widths - Table column widths can also be modified. To change the width of a column, move the mouse over the right edge of the corresponding column header until the mouse pointer changes to a double-sided arrow. ✣

When the mouse pointer changes, drag the column to the desired width. Columns that have been totally collapsed can be restored by double-clicking the mouse on the column header separation (the vertical line in the top row representing the hidden column).

Project Folder

Your building's location and construction type (single family or multifamily) are entered in the *Project* screen. MEC*check* lists the cities for each state. The location and construction type of your building are necessary for MEC*check* to determine compliance. If this information is not accurate, the results will not be valid.

The *Project* screen also has input fields entitled *Date of Plans*, *Title*, *Project*, *Company*, and *Notes*. All of the information entered in these fields is included in your project report. None of this information is required by the software to determine compliance with the code. This information may be useful, however, to the building department or as a way to track and label your reports.



Project Screen

Whenever you exit MEC*check*, the currently selected building location and construction type are saved. When re-entering the software, the location and construction type fields are automatically updated to reflect your last entries.

Project Folder Required Inputs

State To choose a new state, select the arrow button to the right of the field. A list appears containing state names.

City Each time you enter a new state, the list of cities changes – reflecting only the cities located in the new state. To choose a new location, select the arrow button to the right of the field. A list appears containing the names of cities located in the selected state.

Construction Type The code specifies different requirements for single-family and multifamily buildings, so MEC*check* must know which of these construction types you are going to build. You must select either the *Single Family* or the *Multifamily* button.

Single Family To choose single-family construction, click on the *Single Family* radio button with the mouse. Single-family buildings include all detached one- and two-family dwellings.

Multifamily To choose multifamily construction, click on the *Multifamily* radio button with the mouse. Multifamily buildings are three stories or less in height and contain three or more attached dwelling units. Apartments, condominiums, townhouses, dormitories, and rowhouses are included in this category. Multifamily buildings can be considered as a whole or separate reports can be generated for each dwelling unit. Where individual units are identical, one report may be submitted as representative of the others. Contact the authority having jurisdiction to determine which approach to take.

Project Folder Optional Inputs

Date of Plans The *Date of Plans* field is used to record the date stamped on the building plans. This date can be used to track the plans on which the MEC*check* documentation is based, in the event that the plans are later modified.

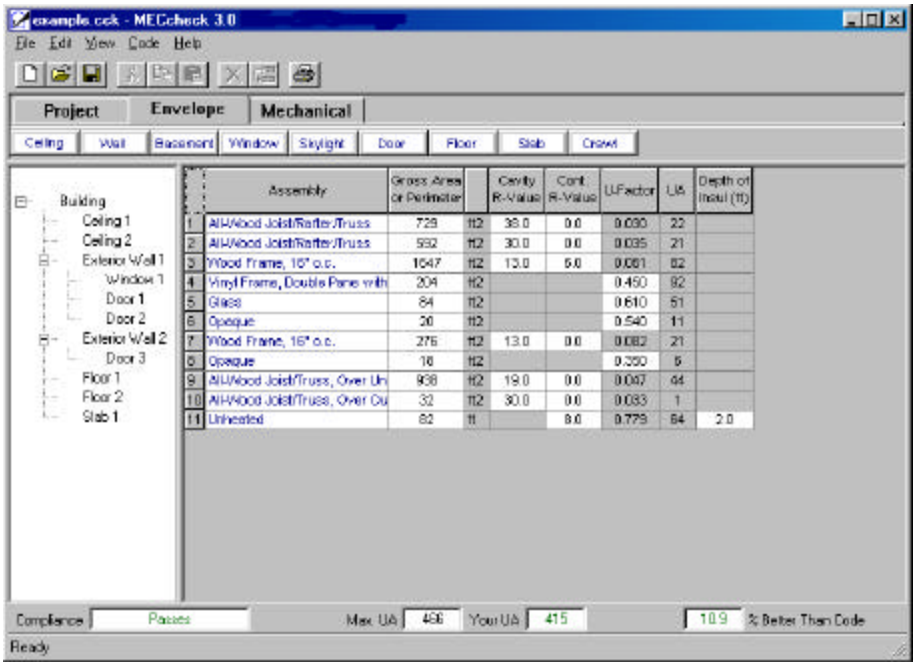
Title The *Title* field is a single-line text field used to enter a project title. You can use the title to identify specific projects. This title is displayed at the top of your report.

Project Enter a description of your project in the *Project* field (such as the project name and address).

Company Enter a description of your company in the *Company* field (such as the name and address).

Notes Enter any additional information in the *Notes* field.

Envelope Folder



Envelope Screen

The blue-on-white buttons at the top of the *Envelope* screen are used for choosing the building components in your proposed design. You can select from buttons representing general building components – ceilings, walls, basement walls, windows, skylights, doors, floors, slab floors, and crawl space walls. When you select any of these buttons the component is added to the table on the *Envelope* screen. The table continues to grow as you add new components. You may add as many components as you need to describe your building, including multiple components of the same type. The status bar message at the bottom of the screen explains what type of information goes into the currently selected field.

After you have filled in the information about each component, the program computes the UA of your proposed building and the UA of the code building. The code building has the same dimensions as your building but conforms to the code requirements. If the total UA of your building is less than or equal to the total UA of the code building, your building complies with the code and the *Compliance* field displays the message "Passes."

Ceilings

Ceilings include opaque portions of the building envelope that are above conditioned space and are horizontal or tilted at less than 60 degrees from horizontal.

Select the *Ceiling* button to add a ceiling component to the description of your design on the *Envelope* screen. Each unique ceiling assembly should be entered as a separate component, but multiple ceiling elements sharing the same construction may be entered as one component with appropriate total area.

Ceiling Types

After selecting the *Ceiling* button, a new ceiling assembly is added to the table and a popup menu is displayed in the *Assembly* field. Choose from the following ceiling types:

All-Wood Joist/Rafter/ Truss — Wood-frame ceiling structures in which insulation is placed between structural ceiling members; e.g., batt or loose-fill insulation in cathedral ceilings or attic spaces.

All-Wood Raised Joist/Rafter/ Truss — Wood-frame ceiling structures with raised or oversized truss construction allowing the insulation to achieve its full thickness over the plate lines of exterior walls (sometimes referred to as an energy truss).

Structural Insulated Panels (SIPs) — Typically 4- to 6-in. stressed-skin panels with foam insulation sandwiched between oriented strand-board (OSB). For SIPs assemblies, you must provide the manufacturer-reported R-value in the *Cont. R-Value* field.

Other — Ceiling assemblies that do not fit into any of the other ceiling types. If you use the *Other* ceiling type, you must enter an overall U-factor for the entire ceiling assembly (including air films). Be prepared to provide the building department with manufacturers' literature or documentation of U-factor calculations.

Ceiling Software Inputs

Gross Area — Enter the gross area of the ceiling component in the *Gross Area or Perimeter* field. The gross ceiling area includes the area of all skylights within the ceiling. You must link the ceiling to the skylights within that ceiling by using the tree on the left side of the *Envelope* screen. To link a skylight to a ceiling assembly, drag the skylight label on the tree to the ceiling label and release the mouse. The ceiling area should be measured on the slope of the finished interior surface.

Cavity Insulation R-Value

Enter the R-value of any insulation to be installed in the cavities between ceiling structural members, including all blown insulation. The insulating values of other parts of the building assemblies (e.g., gypsum board and air films) are accounted for by the program and should not be included.

Continuous Insulation R-Value

Enter the R-value of any continuous ceiling insulation. Continuous insulation is insulation that runs continuously over structural members and is free of significant thermal bridging; such as rigid foam insulation above the ceiling deck. For ventilated ceilings, insulating sheathing must be placed between the conditioned space and the ventilated portion of the ceiling (typically applied to the trusses or rafters immediately behind the drywall or other ceiling finish material). For structural insulated panels, enter the manufacturer-reported R-value for the entire assembly.

Assembly U-Factor

If you have selected the *Other* ceiling type option, enter the overall U-factor of the ceiling assembly including exterior and interior air films. Do not include the finished ceiling in the U-factor calculation if the space between ceiling and ceiling structure is used as an HVAC plenum. Building departments may require supporting documentation for assemblies entered using the *Other* ceiling type and *U-Factor* field.

Walls

Select the *Wall* button to add an above-grade wall component to the description of your design on the *Envelope* screen. Each unique above-grade wall assembly should be entered as a separate component, but multiple wall elements sharing the same construction may be entered as one component with appropriate total area.

Wall Types

Wood Frame, 16" o.c.

Wood frame walls with 16" on-center stud spacing. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.

Wood Frame, 24" o.c.

Wood frame walls with 24-in. on-center. stud spacing. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.

Steel Frame, 16" o.c.

Steel frame (stud) walls of any gauge or depth, with 16" on-center stud spacing. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.

Steel Frame, 24" o.c.

Steel frame (stud) walls of any gauge or depth, with 24" on-center stud spacing. The category is intended primarily for lightweight walls but may also be used for walls with masonry veneers.

Solid Concrete or Masonry

Solid precast or poured-in-place concrete as well as concrete masonry units with grouted cells. In making this selection, you must also indicate whether the insulation will be located on the interior or exterior of the wall. If insulation will be placed on both the interior and exterior of the wall, select the option corresponding to the larger insulative R-value. For example, if R-5 exterior sheathing will be used with R-13 interior cavity insulation on a furred concrete wall, select the *Interior Insulation* option. To receive full credit for light-weight (insulated) concrete walls, use the *Other* wall type.

CMU with Empty Cells

Concrete masonry units (CMUs) with at least 50% of the CMU cells free of grout. In making this selection, you must also indicate whether the insulation will be located on the interior or exterior of the wall. If insulation will be placed on both the interior and exterior of the wall, select the option corresponding to the larger insulative R-value. To receive full credit for light-weight (insulated) concrete walls, use the *Other* wall type.

CMU with Integral Insulation

Concrete masonry units (CMUs) with integral insulation, such as perlite or rigid foam inserts. Integral insulation means insulation placed within the voids of CMUs. Selecting this wall type gives you credit for integral insulation. DO NOT enter values for cavity R-value and continuous R-value unless additional insulation will be installed. In making this selection, you must also indicate whether the additional insulation will be located on the interior or exterior of the wall. If additional insulation will be placed on both the interior and exterior of the wall, select the option corresponding to the larger insulative R-value. To receive full credit for light-weight (insulated) concrete walls, use the *Other* wall type.

Log

Walls constructed from 5" or larger diameter logs.

NOTE: Concrete, masonry, and log walls with 7-in or larger diameter logs receive a mass wall credit in some locations. In order to qualify for this credit, the heat capacity of the exterior wall must be greater than or equal to 6 Btu/ft^2 °F [123 kj/m^2 °K] of exterior wall area. Masonry and concrete walls having a mass greater than or equal to 30 lb/ft^2 of exterior wall area (146 kg/m^2) will meet this requirement. Masonry and concrete walls with lesser mass should be entered as wood-framed walls. Log walls with 5-in and 6-in diameter logs may be entered as log walls, but will not receive the mass wall credit.

Structural Insulated Panels (SIPs)

Typically 4- to 6-in. stressed-skin panels with foam insulation sandwiched between oriented strand-board (OSB). For SIPs assemblies, you must provide the manufacturer-reported R-value in the *Cont. R-Value* field.

Insulated Concrete Forms (ICFs)

ICFs are insulating, stay-in-place forms for poured concrete walls. The forms, which remain a permanent part of the wall assembly, are either pre-formed interlocking blocks or separate panels connected with plastic ties. For ICF systems, you must provide the manufacturer-reported R-value in the *Cont. R-Value* field.

Other

Wall assemblies that do not fit into any of the other above-grade wall types. Also use the *Other* wall type to receive full credit for the extra insulative value of light-weight (insulated) concrete walls. You must enter an overall U-factor for the entire wall assembly (including air films). Be prepared to provide the building department with manufacturers' literature or documentation of U-factor calculations.

Wall Software Inputs

Gross Area

Enter the gross area of the wall component in the *Gross Area or Perimeter* field. The gross wall area includes the area of all windows and doors within the wall. You must link the wall to the windows and doors within that wall by using the tree on the left side of the *Envelope* screen. To link a window or door to a wall, drag the window or door label on the tree to the wall label and release the mouse. The gross wall area also includes the peripheral edges of floors (the area of the band joist and subfloor between floors).

1992 1993

The gross area of the walls of conditioned basements with an average depth less than 50% below grade should be entered as a wall (not as a basement). In this case, the gross wall area includes the below-grade portion of the wall and the areas of doors and windows within those walls.

1995

The gross area of any individual wall of a conditioned basement with an average depth less than 50% below grade should be entered as a wall (not as a basement). In this case, the gross wall area includes the below-grade portion of the wall and the areas of doors and windows within those walls.

Cavity Insulation R-Value

Enter the R-value of any insulation to be installed in the cavities between above-grade wall structural members. The insulating values of other parts of the building assembly (e.g., gypsum board and air films) are accounted for by the program and should not be included.

Continuous Insulation R-Value

Enter the R-value of any continuous insulation in the above-grade wall. Continuous insulation is insulation that is continuous over framing members or furring strips and is free of significant thermal bridging, such as insulating sheathing. The insulating values of other parts of the building assemblies (e.g., gypsum board and air films) are accounted for by the program and should not be entered. For structural insulated panels and insulated concrete forms, enter the manufacturer-reported R-value for the entire assembly.

Assembly U-Factor

If you have selected the *Other* wall type, enter the overall U-factor of the above-grade wall assembly including exterior and interior air films. Building departments may require supporting documentation for assemblies entered using the *Other* wall type and *U-Factor* field.

Basements

1992 1993

Walls of conditioned basements with an average depth 50% or more below grade should be entered using the *Basement* button. Walls of conditioned basements with an average depth less than 50% below grade should be entered as an above-grade wall using the *Wall* button.

1995

Any individual wall of a conditioned basement with an average depth 50% or more below grade should be entered using the *Basement* button. Walls of conditioned basements with an average depth *LESS* than 50% below grade should be entered as an above-grade wall using the *Wall* button.

Select the *Basement* button to add a basement wall component to the description of your design on the *Envelope* screen. Each unique basement wall assembly should be entered as a separate component, but multiple basement wall elements sharing the same construction may be entered as one component with the appropriate total area.

Basement Wall Types

Solid Concrete or Masonry

Solid precast or poured-in-place concrete as well as concrete masonry units with grouted cells. To receive full credit for light-weight (insulated) concrete walls, use the *Other* basement wall type.

CMU with Empty Cells

Concrete masonry units (CMUs) with at least 50% of the CMU cells free of grout. To receive full credit for light-weight (insulated) concrete walls, use the *Other* basement wall type.

CMU with Integral Insulation

Concrete masonry units (CMUs) with integral insulation, such as perlite or rigid foam inserts. Integral insulation means insulation placed within the voids of CMUs. Selecting this wall type gives you credit for integral insulation. DO NOT enter values for cavity R-value and continuous R-value unless additional insulation will be installed. To receive full credit for light-weight (insulated) concrete walls, use the *Other* basement wall type.

Wood Frame

Wood-frame walls with any stud spacing.

Insulated Concrete Forms (ICFs)

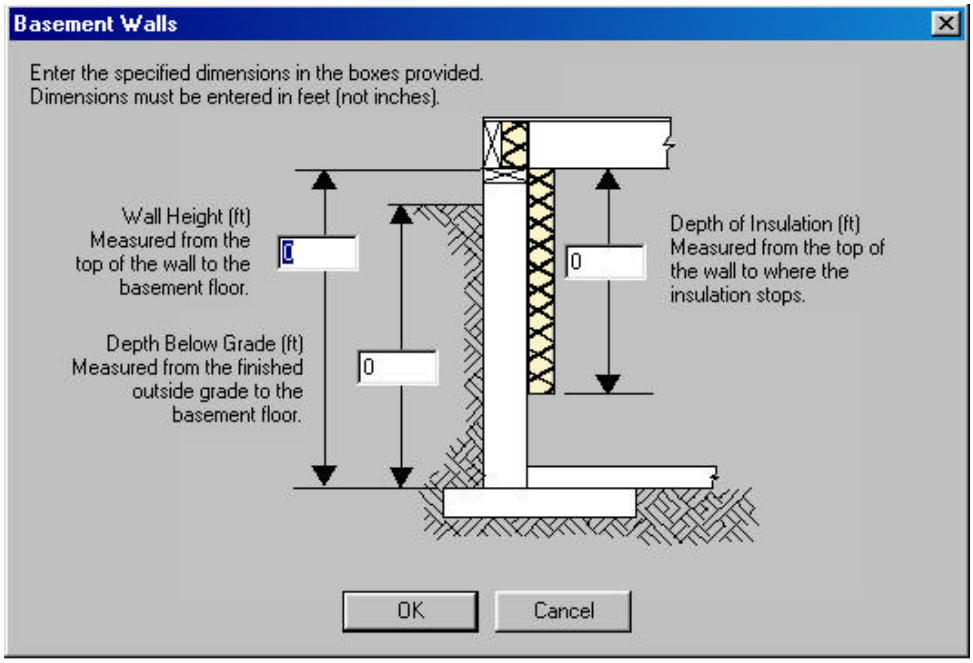
ICFs are insulating, stay-in-place forms for poured concrete walls. The forms, which remain a permanent part of the wall assembly, are either pre-formed interlocking blocks or separate panels connected with plastic ties. For ICF systems, you must provide the manufacturer-reported R-value in the *Cont. R-Value* field.

Other

Basement wall assemblies that do not fit into any of the other basement wall types. Also use the *Other* basement wall type to receive full credit for the extra insulative value of light-weight (insulated) concrete walls. If you use the *Other* basement wall type, you must enter an overall U-factor for the entire wall assembly (including interior air film but excluding earth). Be prepared to provide U-factor calculations or documentation from manufacturer's literature to the building department.

Basement Software Inputs

After selecting a basement wall type, a basement wall illustration will appear with input boxes for the basement wall height, depth below grade, and depth of insulation. The illustration helps identify the dimensions being requested. You may enter basement wall dimensions directly into this illustration and select the *OK* button to have them transferred to the corresponding row in the table on the *Envelope* screen. If you prefer to enter the dimensions directly into the table on the *Envelope* screen, you can select *Cancel* to remove the illustration without entering dimensions. To view the basement wall illustration and inputs at a later time, click the right-mouse button anywhere on the basement row and select *Edit Basement Inputs* from the popup menu.



Wall Height (ft) Provide the height of the wall (ft) as measured from the top of the wall to basement floor. If the height is not uniform, provide an average height. If you are entering a partial basement wall component (such as wood kneewalls), enter the height of the wall section instead of the height of the entire wall.

Depth B.G. (ft) Provide the depth (ft) that the wall extends from the finished grade surface to the basement floor. If the grade is sloped or uneven, provide an average depth below grade. If you are entering a partial basement wall component (such as wood kneewalls), enter the depth below grade of the wall section instead of the depth below grade of the entire wall. For wood kneewalls, the wall section may be entirely above grade, in which case you would enter 0.

Depth of Insul (ft) Basement insulation requirements are for the full depth of the basement wall (up to 10 ft). MEC*check*, however, allows the depth of the basement wall insulation to be traded against other envelope components. Therefore, you must indicate the depth (ft) of the insulation you intend to install on your basement wall as measured from the top of the wall to where the insulation stops. The insulation must extend from the top of the basement wall downward to a depth equal to the value entered in this field. Note that for a fully insulated wall the depth of insulation should be equal to the height of the wall. For basement walls with non-uniform insulation depths, enter an average. MEC*check* accepts basement insulation depths from 0 to 12 ft. If you enter an insulation depth of 0, the program assumes no insulation is installed regardless of the values in the *Cavity R-Value* and *Cont. R-Value* fields.

Gross Area

Enter the gross area of the basement wall component in the *Gross Area or Perimeter* field. The gross basement wall area includes the area of all windows and doors within the wall. You must link the wall to the windows and doors within that wall by using the tree on the left side of the *Envelope* screen. To link a window or door to a wall, drag the window or door label on the tree to the wall label and release the mouse.

The gross area of any individual wall of a conditioned basement with an average depth less than 50% below grade should be entered as a wall (not as a basement).

Cavity Insulation R-Value

If the basement will be furred, provide the R-value of the insulation to be installed between furring in the *Cavity R-Value* field. Do not include the R-value of other materials (such as interior drywall).

Continuous Insulation R-Value

Enter continuous insulation in the *Cont. R-Value* field. Continuous insulation includes exterior rigid foam products and any continuous insulation installed on the exterior or interior of an unfurred basement wall. For ICFs, enter the manufacturer-reported R-value for the entire assembly in the *Cont. R-Value* field.

Georgia

The **Georgia Residential Code** does not allow below-grade exterior foam plastics. If a non-zero value is entered in the *Cont. R-Value* field, the output report will identify this entry as interior continuous insulation.

Example 1: Wood Kneewalls

Assume a basement is to be constructed with 3-ft-high wood kneewalls built on a 5-ft-high concrete foundation. R-13 insulation will be installed in the wood kneewall cavities and R-5 rigid insulation will be installed on the concrete foundation walls.

The wood kneewalls are completely above grade and fully insulated. The concrete foundation walls are 4 ft. below grade and fully insulated.

Create one basement wall component for the wood kneewalls and enter the following information:

- Wall Height 3 ft.
- Depth B.G. 0 ft.
- Depth of Insul 3 ft.

Create a second basement wall component for the concrete foundation and enter the following information:

- Wall Height 5 ft.
- Depth B.G. 4 ft.
- Depth of Insul 5 ft.

Two basement wall components will be added to your list of building components. Provide the gross wall area of the wood kneewalls and enter the insulation R-value as R-13 in the *Cavity R-Value* field. Provide the gross wall area of the concrete foundation walls and enter the cavity R-value as R-5 in the *Cont. R-Value* field.

Example 2: Walk-Out Basement

Assume an 8-ft. basement is to be built on a slope so that the front wall is 7 ft. below grade and the rear wall is totally above grade. The ground level along both side walls is sloped so that approximately 50% of each wall is below grade. The rear basement wall will be wood-frame construction with R-19 cavity insulation. The other three walls will be concrete walls with R-10 rigid insulation. All four walls will be fully insulated.

Create one basement component for the front wall and enter the following information:

- Wall Height 8 ft.
- Depth B.G. 7 ft.
- Depth of Insul 8 ft.

The two side walls are at least 50% below grade, so they are entered as a basement wall component. If they were less than 50% below grade, they would be entered as an above-grade wall component. Therefore, create a second basement wall component for the two side walls and enter the following information:

- Wall Height 8 ft.
- Depth B.G. 4 ft.
- Depth of Insul 8 ft.

The rear wall is fully above grade and should be entered as an above-grade wall using the *Wall* button. Note that the basement floor along this wall should be considered a slab-on-grade component. Create a slab component using the *Slab* button and enter the length of the basement floor along this wall in the *Gross Area or Perimeter* field.

Example 3: Below-Grade Exterior Insulation

An 8-ft. high by 21-ft. wide foundation wall is 7 ft. below grade and is to be insulated using R-5 exterior rigid foam. The insulation will start at grade level and run down to the bottom of the foundation wall. There is 1 foot of uninsulated exposed above-grade wall. The wall has no openings.

This wall is entered in MEC*check* by creating two basement wall components. The first component will be used for entering the uninsulated above-grade portion of the wall.

Select the *Basement* button and enter the following information:

- Wall Height 1 ft.
- Depth B.G. 0 ft.
- Depth of Insul 0 ft.

The second component will be used for entering the insulated below-grade portion of the wall. Select the *Basement* button again and enter the following information:

- Wall Height 7 ft.
- Depth B.G. 7 ft.
- Depth of Insul 7 ft.

After these components have been created, enter the gross area of each component and the R-value of the insulation used on the below-grade component.

Example 4: Draped Interior Insulation

Some builders choose to insulate the interior of basement walls with faced insulation batts. Some products have reinforced stapling tabs at the top and bottom of the batts for installation on furring strips using a hammer-stapler. They might also be power-nailed directly to a solid concrete or block wall or installed on pins glued directly to the foundation wall. The batts typically come in 4-ft. wide rolls, and are sometimes installed on only the top four feet of the wall.

A solid concrete basement has 10-ft. high walls and is buried 9 ft. below grade. Foil faced, R-11 basement batt insulation is to be installed on the first four feet of the interior of the

basement walls. Select the *Basement* button, select the *Solid Concrete or Masonry* option, and enter the following information:

- Wall Height 10 ft.
- Depth B.G. 9 ft.
- Depth of Insul 4 ft.

With these inputs, the software will assume the lower 6 ft. of the wall is uninsulated. The R-value of the uninsulated concrete wall is provided by the software and should not be entered by the user. After the basement component has been created, enter the sum of the gross area of all exterior basement walls in the *Gross Area or Perimeter* field and enter the assembly R-value (R-11) in the *Cont. R-Value* field. Note that the gross area equals the sum of the insulated and uninsulated areas.

Windows

Windows are defined as any transparent or translucent section in an exterior building wall including glass block but excluding glass doors (which are entered using the *Door* button). Glazing having a slope greater than 60 degrees from horizontal is considered a window while glazing having a slope less than 60 degrees from horizontal is considered a skylight.

Select the *Window* button to add a window component to the description of your design on the *Envelope* screen. Each unique window assembly should be entered as a separate component, but multiple window elements having the same characteristics may be entered as one component with an appropriate total area.

Windows must be linked to their corresponding wall component. Link a window to a wall by using the tree on the left side of the *Envelope* screen. Drag the window or door label on the tree to the wall label and release the mouse. Windows in the exterior walls of conditioned basements should be included in the table and should be linked to their corresponding basement wall assembly. Windows in unconditioned basements are *NOT* included.

Window Types

Frame Type The frame type enables you to identify the window frame material. Use *Other* for frame types that do not fit into any of the other frame types.

Glazing Layers The glazing layers enables you to identify the number of glazing layers in the windows (i.e., single, double, or triple). *Double Pane with Low-E* is included because the performance impact of low-emissivity films is similar to that of additional glass layers.

Window Software Inputs

Gross Area Enter the area of the entire window component in square feet. Window area is the interior surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. The nominal area or rough opening is also acceptable for flat windows.

U-Factor 1992 1993 Enter the U-factor for each component in its corresponding *U-Factor* field. U-factors for glazing should be tested and documented by the manufacturer in accordance with the NFRC test procedure, taken from the default glazing U-factors table in Appendix B, or derived from an alternate test procedure or table accepted by your local jurisdiction. Center-of-glass U-factors cannot be used.

U-Factor 1995 Enter the U-factor for each component in its corresponding *U-Factor* field. U-factors for glazing must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from the default glazing U-factors table in Appendix B. Center-of-glass U-factors cannot be used.

Skylights

Skylights are defined as any transparent or translucent section in a building ceiling. Glazing having a slope less than 60 degrees from horizontal is considered a skylight, while glazing having a slope greater than 60 degrees from horizontal is considered a window.

Select the *Skylight* button to add a skylight component to the description of your design on the *Envelope* screen. Each unique skylight assembly should be entered as a separate component, but multiple skylight elements having the same characteristics may be entered as one component with the appropriate total area.

Skylights must be linked to their corresponding ceiling component. Link a skylight to a ceiling by using the tree on the left side of the *Envelope* screen. Drag the skylight label on the tree to the ceiling label and release the mouse.

Skylight Types

Frame Type The frame type enables you to identify the skylight frame material. Use *Other* for frame types that do not fit into any of the other frame types.

Glazing Layers The glazing layers enables you to identify the number of glazing layers in the skylights (i.e., single, double, or triple). *Double Pane with Low-E* is included because the performance impact of low-emissivity films is similar to that of additional glass layers.

Skylight Software Inputs

Gross Area Enter the area of the entire skylight component in square feet. Skylight area is the interior surface area of the entire assembly, including glazing and framing elements. The nominal area or rough opening is also acceptable.

U-Factor 1992 1993 Enter the U-factor for each component in its corresponding *U-Factor* field. U-factors for glazing should be tested and documented by the manufacturer in accordance with the NFRC test procedure, taken from the default glazing U-factors table in Appendix B, or derived from an alternate test procedure or table accepted by your local jurisdiction. Center-of-glass U-factors cannot be used.

U-Factor 1995 Enter the U-factor for each component in its corresponding *U-Factor* field. U-factors for glazing must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from the default glazing U-factors table in Appendix B. Center-of-glass U-factors cannot be used.

Doors

Select the *Door* button to add a door component to the description of your design on the *Envelope* screen. Each unique door assembly should be entered as a separate component, but multiple door elements sharing the same construction may be entered as one component with the appropriate total area.

Door Types

Opaque Exterior doors that are mostly opaque (i.e., glass covers 50% or less of the door's area).

Glass Exterior doors that are mostly glazed (i.e., glass covers more than 50% of the door's area).

Other Exterior doors that do not fit into any of the other door types. You must enter a U-factor and you should be prepared to provide the building department with manufacturers' literature or documentation of U-factor calculations.

Door Software Inputs

Gross Area Enter the total area of the door in square feet including any glazed portions. The nominal area or rough opening is also acceptable.

U-Factor 1992 1993 Door U-factors must be based on manufacturer data, taken from the default door U-factors table in Appendix B, or derived from an alternate test procedure or table accepted by your local jurisdiction.

U-Factor 1995 Door U-factors must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from the default door U-factors table in Appendix B.

If the door is rated with an aggregate R-value (an R-value that includes both the glass and opaque area), the following equation applies:

$$\text{U - Factor} = \frac{1}{\text{R - Value}}$$

If an opaque door contains glass and an aggregate R-value or U-factor rating for that door is not available, enter the door's glass area as a separate glazing component, enter the opaque area as an opaque door component, and enter an opaque door U-factor taken from the table in Appendix B. The U-factors listed in Appendix B are only for doors without glass.

Floors

Select the *Floor* button to add a floor component to the description of your design on the *Envelope* screen. Each unique exposed floor assembly should be entered as a separate component, but multiple floor elements sharing the same construction may be entered as one component with the appropriate total area.

Floor Types

All-Wood Joist/Truss Any structural wood floor in which insulation is placed between the structural members; e.g., batt insulation between wood floor joists.

Structural Insulated Panels (SIPs) Typically 4- to 6-in. stressed-skin panels with foam insulation sandwiched between oriented strand-board (OSB). For SIPs assemblies, you must provide the manufacturer-reported R-value in the *Cont. R-Value* field.

Other Floor assemblies that do not fit into any of the other floor types. You must enter an overall U-factor for the entire floor assembly (including air films). Be prepared to provide the building department with manufacturers' literature or documentation of U-factor calculations.

Floor Location For all floor types you must also indicate whether the floor is located over an unconditioned space or over outside air. Floors over unconditioned space include all floors over unconditioned (neither heated nor cooled) basements, crawl spaces, and garages. Floors over outdoor air include floor cantilevers, floors of an elevated home, and floors over overhangs (such as the floor directly above a recessed entryway or open carport). Floors over heated spaces are not part of the building envelope and should not be included. Concrete slab-on-grade floors are entered separately using the *Slab* button.

Floor Software Inputs

Gross Area Enter the gross area of the floor (in square feet) along the boundary where it separates conditioned from unconditioned space.

Cavity Insulation R-Value Enter the R-value of any insulation to be installed in the cavities between floor structural members. The insulating values of other parts of the building assembly (e.g., subfloor and air films) are accounted for by the program.

Continuous Insulation R-Value

Enter the R-value of any continuous floor insulation. Continuous insulation is insulation that runs continuously over structural members and is free of significant thermal bridging. The insulating values of other parts of the building assembly (e.g., subfloor and air films) are accounted for by the program.

Assembly U-Factor

If you have selected the *Other* floor type option, you must enter the overall U-factor of the floor assembly including exterior and interior air films. Building departments may require supporting documentation for assemblies entered using the *Other* floor type and *U-Factor* field.

Slab Floors

Select the *Slab* button to add a concrete slab-on-grade component to the description of your design on the *Envelope* screen. Slab-on-grade components include all slab edges that are part of the building envelope and are less than 12 in. below grade (i.e., all edges separating conditioned from unconditioned space). Edges of slab floors over 12 in. below grade (such as basement floors) are not subject to code requirements and do not need to be entered in the software. Each unique concrete slab/insulation combination (i.e., insulation R-value and depth) should be entered separately, but all slabs sharing insulation methods may be entered as a single component with the appropriate total perimeter length.

Slab Types

Unheated

A slab that is not heated (see below).

Heated

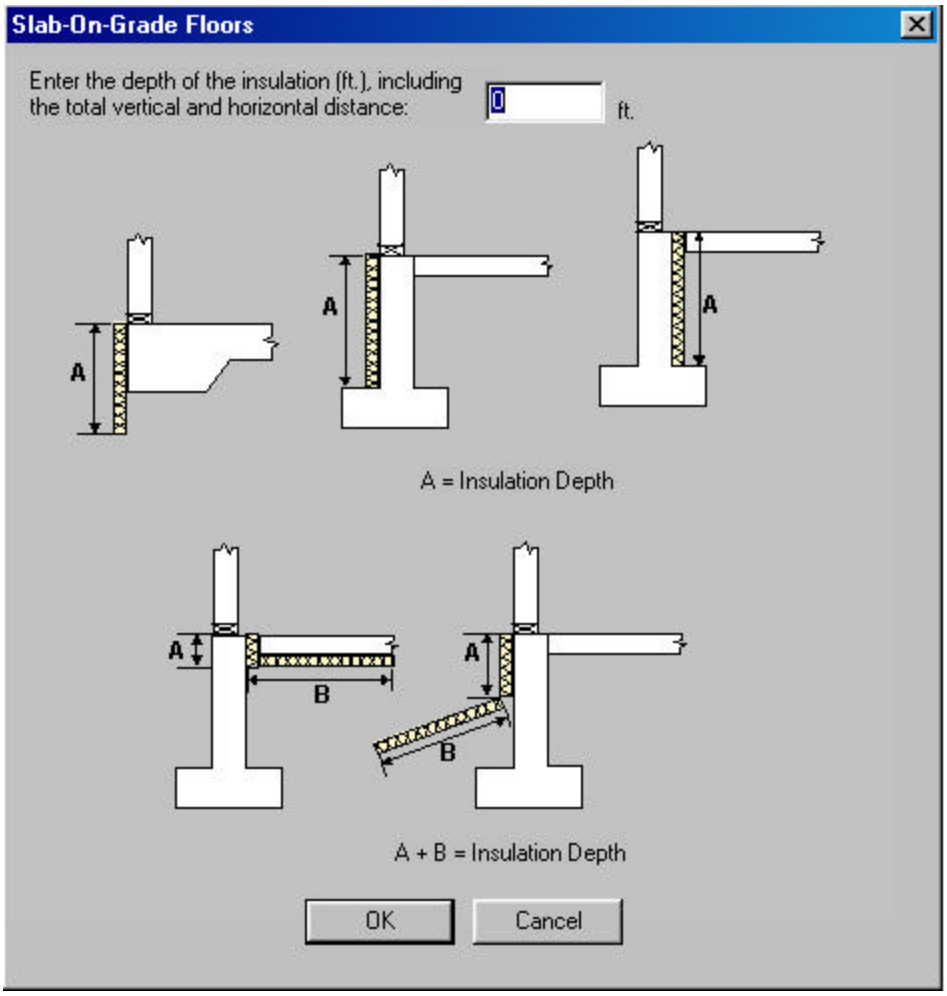
A heated slab is one in which the heating elements or hot air distribution system is in contact with or placed within the slab or the subgrade. Heated slabs have higher insulation requirements than unheated slabs under the code.

Georgia

The **Georgia Residential Code** does not allow below-grade exterior foam plastics, but does give some credit for carpet or hardwood on plywood applied to slab floors. If the code is set to *Georgia*, you will also be asked to indicate whether the slab is covered with either of these treatments.

Slab Software Inputs

After selecting a slab type, an illustration of various slab configurations will appear with an input box for the depth of insulation. The illustration helps identify the dimension being requested for various insulation configurations. You may enter the depth of insulation directly into this illustration and select the *OK* button to have it transferred to the corresponding row in the table on the *Envelope* screen. If you prefer to enter the insulation depth directly into the table on the *Envelope* screen, you can select *Cancel* to remove the illustration without entering a value. To view the slab illustration at a later time, click the right-mouse button anywhere on the slab row and select *Edit Slab Input* from the popup menu.



Depth of Insulation — Enter the depth (ft) of the insulation you intend to install as measured from the top of the slab to where the insulation stops. This distance should include the total vertical plus horizontal distance. Refer to the glossary definition of *Slab Insulation* for a description and illustration of acceptable configurations. If you enter a depth of 0, the program assumes no insulation is to be installed.

Perimeter — Enter the perimeter of the on-grade slab component in feet in the *Gross Area or Perimeter* field. The slab perimeter should include the length of all edges of a slab foundation that are part of the building envelope and are less than 12 in. below grade.

Continuous R-Value — Enter the R-value of the slab perimeter insulation.

Georgia — The **Georgia Residential Code** does not allow below-grade exterior foam plastics. The *Cont. R-Value* field is disabled when the code is set to *Georgia*.

Crawl Space Walls

The crawl space wall option is for walls of unventilated crawl spaces (i.e. not directly vented to the outside). If you are insulating the floor above the crawl space, do not use the crawl space walls option.

Select the *Crawl* button to add a crawl space wall component to the description of your design on the *Envelope* screen. Each unique crawl space wall assembly should be entered as a separate component, but multiple crawl space wall elements sharing the same construction may be entered as one component with the appropriate total area.

Crawl Space Wall Types

Solid Concrete or Masonry — Solid precast or poured-in-place concrete as well as concrete masonry units with grouted cells. To receive full credit for light-weight (insulated) concrete walls, use the *Other* crawl space wall type.

CMU with Empty Cells — Concrete masonry units (CMUs) with at least 50% of the CMU cells free of grout. To receive full credit for light-weight (insulated) concrete walls, use the *Other* crawl space wall type.

CMU with Integral Insulation — Concrete masonry units (CMUs) with integral insulation, such as perlite or rigid foam inserts. Integral insulation means insulation placed within the voids of CMUs. Selecting this wall type gives you credit for integral insulation. DO NOT enter values for cavity R-value and continuous R-value unless additional insulation will be installed. To receive full credit for light-weight (insulated) concrete walls, use the *Other* crawl space wall type.

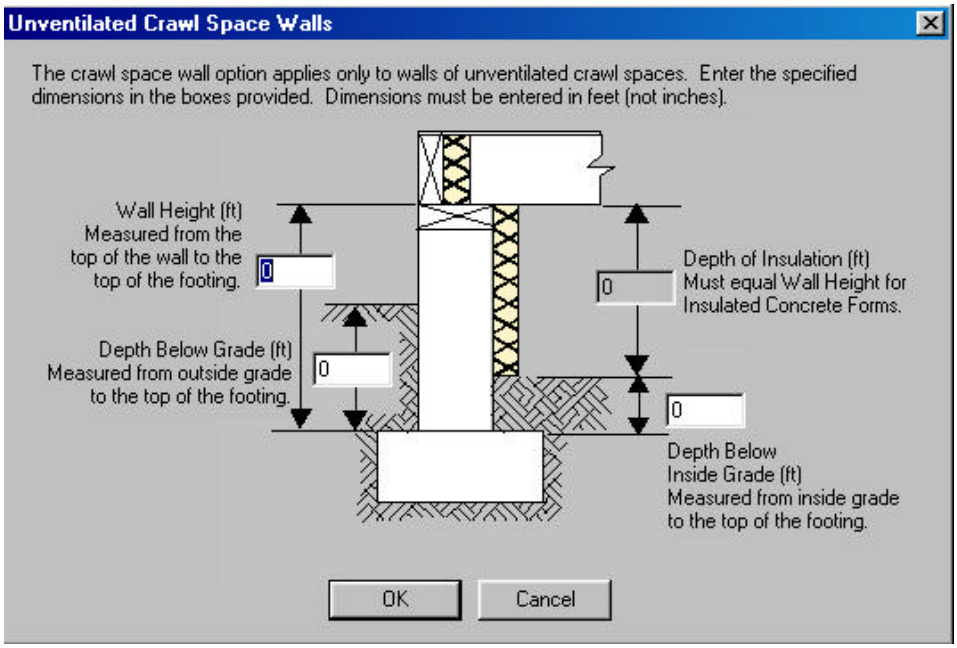
Wood Frame — Wood-frame walls with any stud spacing.

Insulated Concrete Forms (ICFs) — ICFs are insulating, stay-in-place forms for poured concrete walls. The forms, which remain a permanent part of the wall assembly, are either pre-formed interlocking blocks or separate panels connected with plastic ties. For ICF systems, you must provide the manufacturer-reported R-value in the *Continuous R-Value* field.

Other — Crawl space wall assemblies that do not fit into any of the other crawl space wall types. Also use the *Other* crawl space wall type to receive full credit for the extra insulative value of light-weight (insulated) concrete walls. If you use the *Other* crawl space wall type, you must enter an overall U-factor for the entire wall assembly (including interior air film but excluding earth). Be prepared to provide U-factor calculations or documentation from manufacturer's literature to the building department.

Crawl Space Wall Software Inputs

After selecting a crawl space wall type, a crawl space wall illustration will appear with input boxes for the crawl space wall height, depth below grade, depth of insulation, and depth below inside grade. The illustration helps identify the dimensions being requested. You may enter crawl space wall dimensions directly into this illustration and select the *OK* button to have them transferred to the corresponding row in the table on the *Envelope* screen. If you prefer to enter the dimensions directly into the table on the *Envelope* screen, you can select *Cancel* to remove the illustration without entering dimensions. To view the crawl space wall illustration and inputs at a later time, click the right-mouse button anywhere on the crawl space row and select *Edit Crawl Inputs* from the popup menu.



Wall Height	Provide the height of the wall (ft) as measured from the sill to the top of the footing.
Depth B.G.	Provide the depth (ft) that the wall extends from the outside finished grade surface to the top of the footing.
Depth of Insul	Provide the depth (ft) of the insulation you intend to install as measured from the top of the wall to where the insulation stops. This distance should include the total vertical plus horizontal distance. Because the horizontal distance is included, the depth of insulation may be greater than the height of the wall. If you enter a depth of 0, the program assumes no insulation is to be installed.
Inside Depth B.G.	Provide the depth (ft) as measured from the inside grade to the top of the footing.
Gross Area	Enter the gross area of the crawl space wall component in the *Gross Area or Perimeter* field. The area should include the area of the entire wall as measured from the sill to the top of the footing, even if only a portion of the wall is insulated.
Cavity Insulation R-Value	Provide the R-value of any insulation to be installed between structural members in the *Cavity R-Value* field. Do not include the R-value of other materials.
Continuous Insulation R-Value	Continuous insulation includes exterior rigid foam products and any continuous insulation installed on the exterior or interior of the wall. For ICFs, enter the manufacturer-reported R-value for the entire assemly in the *Cont. R-Value* field.
Georgia	The **Georgia Residential Code** does not allow below-grade exterior foam plastsics. If a non-zero value is entered in the *Cont. R-Value* field, the output report will identify this entry as interior continuous insulation.

Mechanical Folder

Use the blue-on-white buttons at the top of the *Mechanical* folder to enter the HVAC equipment in your proposed design. Completion of this section of the software is entirely optional. However, using high-efficiency HVAC equipment may improve the percentage by

which your building compares with the code building. The message at the bottom of the screen explains what type of information goes into the currently selected field.

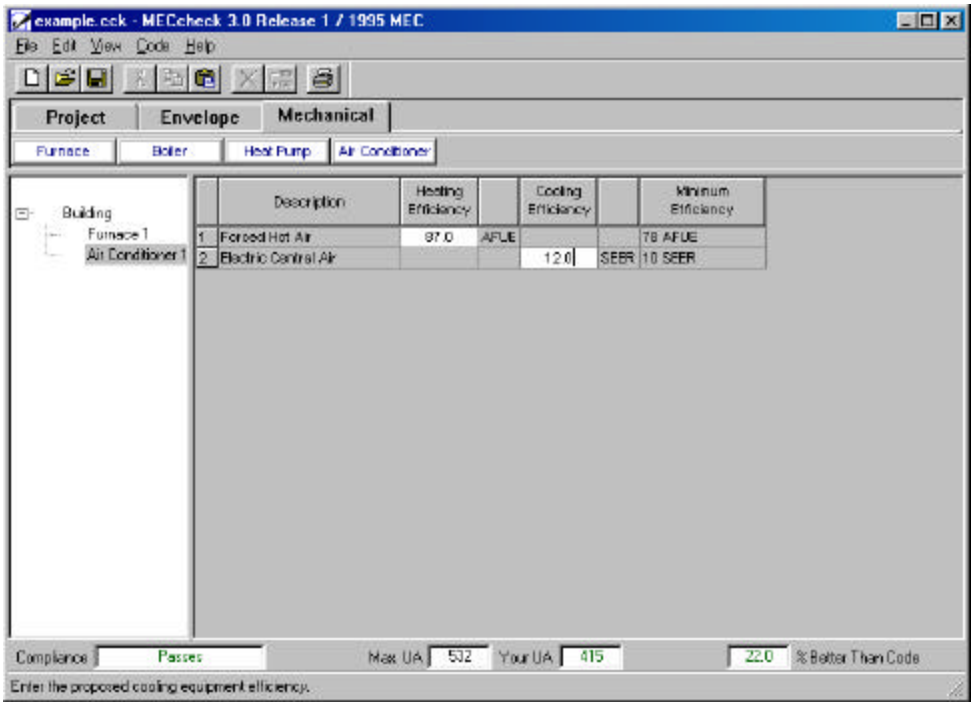
HVAC Efficiency

Trade-offs are allowed for efficient gas and oil furnaces, boilers, and electric heat pumps and air conditioners. No credit is given for electric resistance heating.

Minimum-required heating and cooling equipment efficiencies set by NAECA are displayed in the *Minimum Efficiency* column. If the efficiency of the equipment you plan to install exceeds these minimums, you qualify for the high-efficiency equipment credit. Enter the annual fuel utilization efficiency (AFUE), heating seasonal performance factor (HSPF), or seasonal energy efficiency ratio (SEER) in the appropriate column.

You can receive credit for only one piece of heating equipment and one piece of cooling equipment (or a single heat pump). When multiple heating equipment or multiple cooling equipment is entered, the least efficient equipment will be used to determine compliance.

The high-efficiency equipment credit is applied as a percent increase in the code house UA. To see how much credit you are getting, observe the UA value displayed in the *Max. UA* field. The UA will probably be smaller before taking the credit than after. Some locations along the California coast do not qualify for the cooling equipment credit.



Mechanical Screen

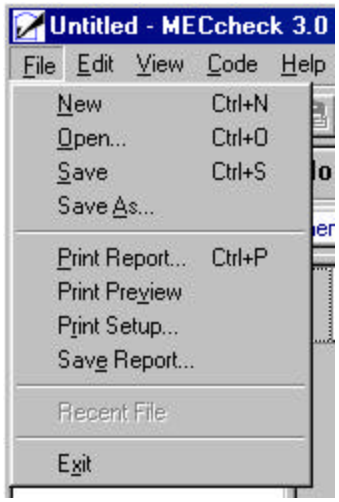
Menus

The menu bar located at the top of the *Envelope* screen is used to select the ***F**ile, **E**dit, **V**iew, **C**ode, and **H**elp* menus.

File Menu

The data you enter into MEC*check* can be stored on your hard disk in a project data file. Separate data files can be created for different building projects or for alternate designs of the same project. Data files allow you to retrieve and alter designs at any time. Report files allow you to print the information you have entered and to document the compliance results determined by MEC*check*. The ***F****ile* menu contains options allowing you to create (***N****ew*), retrieve (***O****pen*), and save project data files and to print project reports.

Data files created by MEC*check* must have the extension .CCK, and report files must have the extension .RPT. If you prefer, when you are asked to provide a filename, you may leave the extensions off and let MEC*check* enter them for you.



File Menu

N*ew*

The ***N****ew* option allows you to erase the current data and begin a new project data file. When you select ***N****ew* and unsaved data exists, MEC*check* asks if you wish to save the current data. Select ***Y****es* to save the current data or ***N****o* if you do not want to save the current data. If you select ***Y****es* and a file is already open, the open file is updated to contain the current data. If no file is open, the *Files* screen appears and you are asked for a filename to which the data will be saved. You can also open a new file by selecting the corresponding icon from the toolbar.

O*pen*

When you want to revise or examine an existing file, you must retrieve a copy of the file by bringing it to the screen. This is referred to as opening the file. The ***O****pen* option allows you to open an existing project data file. When you select ***O****pen*, the *Files* screen appears and you are asked for the filename of the project data file to retrieve. If unsaved data exists, you are asked if you wish to save the current data before opening the new file. If an unsaved file is already open, you are asked if you wish to save the currently open file before opening the new file. You can also open an existing file by selecting the corresponding icon from the toolbar.

S*ave*

The ***S****ave* option allows you to save your current data to the filename shown on the title bar. If no file is open, the *Files* screen appears and you are asked for a filename. You can also save data by selecting the corresponding icon from the toolbar.

Save As The *Save As* option allows you to save your current project data file to a new name. This option is useful when an existing file is opened then modified. If you want to save copies of both the original and the modified file, use *Save As* to rename the modified file.

***P**rint Report* This option allows you to print a report listing project data and compliance results. A popup window is displayed from which you can elect to print a *Compliance Report*, an *Inspection Checklist*, or both. After choosing the report types to print, the *Print* dialog box will appear allowing you to select the number of copies and the printer. You can also print reports by selecting the corresponding icon from the toolbar. The print icon can be used for direct printing, in which case the printer setup dialog is not displayed and the report is sent to the default printer.

Print Preview Select this option to view the *Compliance Report* and/or *Inspection Checklist* before printing.

Print Setup Select this option to change printer settings.

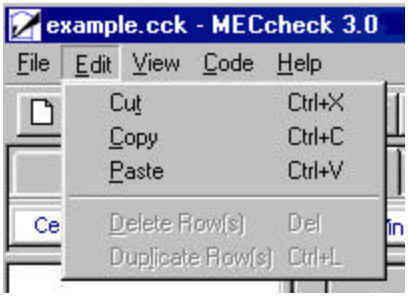
Save Report This option allows you to save a report to a file. A popup window is displayed from which you can elect to generate a *Compliance Report*, an *Inspection Checklist*, or both. After choosing the report types, the *Save Report* dialog box will appear allowing you to provide a name for the file. The report will be saved in Rich Text Format (RTF), which can be loaded into most text processing software.

Exit The *Exit* option allows you to exit MEC*check*.

Edit Menu

Use the ***E**dit* menu to cut, copy, and paste data in editable fields, and to delete and duplicate entire rows. Editable fields include:

- The *Date of Plans*, *Title*, *Project*, *Company*, and *Notes* fields on the *Project* screen
- All black-on-white (or red-on-white) fields in the tables on the *Envelope* and *Mechanical* screens
- The tree labels corresponding to these tables when in edit mode (tree labels are put into edit mode by double-clicking on them).



Edit Menu

Cut The *Cut* option will delete highlighted text in an editable field and copy it to the clipboard. The deleted text can be pasted into another editable field. You can also cut text by selecting the corresponding icon from the toolbar.

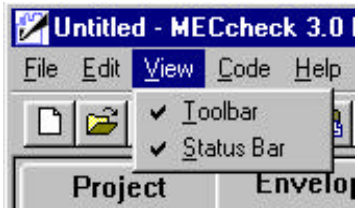
Copy The ***Copy*** option will copy highlighted text in an editable field to the clipboard. The copied text can be pasted into another editable field. You can also copy text by selecting the corresponding icon from the toolbar.

Paste The ***Paste*** option will paste the last copied text into the selected field at the current cursor location. You can also paste text by selecting the corresponding icon from the toolbar.

Delete Row(s) The ***Delete Row(s)*** option will delete all selected rows. To select a row, click on the tree label corresponding to that row or click on the leftmost column of that row (the column containing row numbers). Multiple consecutive rows can be selected by holding down the left mouse button on the left-hand column and dragging it over the desired rows. Non-consecutive rows can be selected by holding down the **Ctrl** key while clicking on the leftmost column of each row to be selected. You can also delete rows by selecting the corresponding icon from the toolbar.

Duplicate Row(s) The *Duplicate Row(s)* option will duplicate one or more consecutive selected rows. If non-consecutive rows are selected, this option will be disabled. To select a row, click on the tree label corresponding to that row or click on the leftmost column of that row (the column containing row numbers). Multiple consecutive rows can be selected by holding down the left mouse button on the left-hand column and dragging it over the desired rows. You can also duplicate rows by selecting the corresponding icon from the toolbar.

View Menu



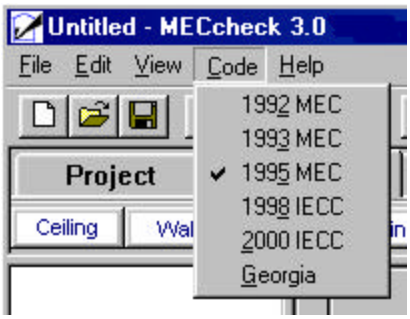
View Menu

Toolbar Toggle the ***Toolbar*** option to display and hide the toolbar at the top of the screen.

Status Bar Toggle the ***Status Bar*** option to display and hide the status bar at the bottom of the screen.

Code Menu

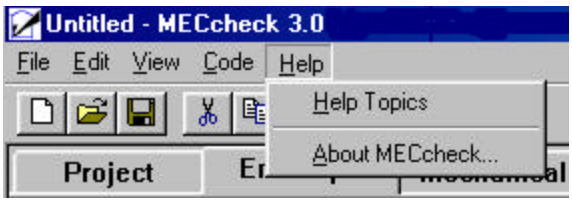
The ***Code*** menu is used to select the code edition applicable to your jurisdiction.



Code Menu

Help Menu

The ***H**elp* menu provides general information on how to use MEC*check*.



Help Menu

***H**elp Topics* — The ***H**elp Topics* option displays the help topics available for MEC*check*.

***A**bout MECcheck* — The ***A**bout MECcheck* option displays the program's version number and release date.

Context Menu

Clicking the right mouse button on a tree label or table displays a pop-up list, referred to as a context menu. The context menu options are applied to a single field in a table or to an entire row in a table, depending on where the mouse is clicked. If the mouse is clicked on a tree label, the menu options are applied to the row corresponding to that label. If the mouse is clicked on the left field of a row in a table, the row is selected and the options are applied to the entire row. Some options are applicable to individual fields of a table, and the mouse must be clicked on the given field to activate the option.

*Cu**t**, **C**opy, **P**aste* — The *Cu**t**, **C**opy*, and ***P**aste* options are available from the ***E**dit* menu in the menu bar, from toolbar buttons, and from the context menu. See the *Edit Menu* section for a description of these options. The *Cu**t**, **C**opy*, and ***P**aste* options are applied to individual fields in a table.

***D**elete Row(s), Dup**l**icate Row(s)* — The ***D**elete Row(s), Dup**l**icate Row(s)* options are available from the ***E**dit* menu, the toolbar, and the context menu. See the *Edit Menu* section for a description of these options. The ***D**elete Row(s), Dup**l**icate Row(s)* options apply to selected rows.

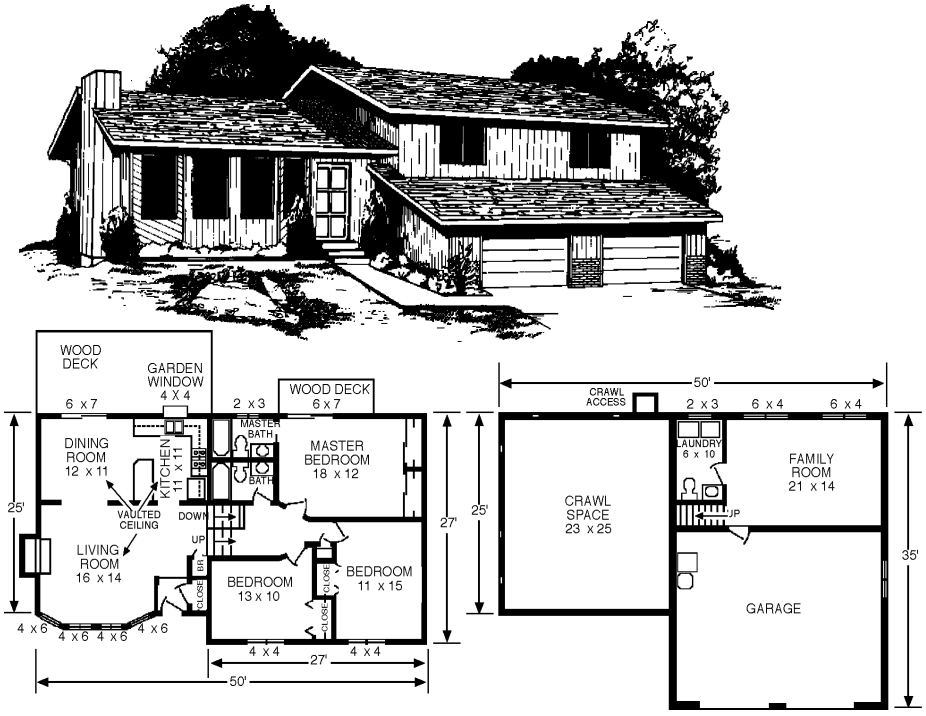
***U**se Default* — The ***U**se Default* option enables you to enter a default U-factor for windows, skylights, and doors that do not have an NFRC rating. The ***U**se Default* option can be selected by clicking the right mouse button in the *U-Factor* column of any window, skylight, or door assembly. A table of default U-factors based on characteristics of the given assembly will be displayed. Choose the U-factor corresponding to the characteristics of your assembly, then select the *OK* button to transfer this default to the table on the *Envelope* screen.

Edit Text The ***Edit Text*** option is used to edit the text on a tree label. When you create a new envelope assembly or HVAC component, a new row appears in the corresponding table and a new tree label appears on the tree to the left. The tree labels are assigned default names such as *Roof 1*. These labels can be changed by clicking the right mouse button on the label and selecting ***Edit Text*** from the context menu. An edit box will become visible where the label used to be, and you can rename the label by typing in the edit box. Press **Enter** or click elsewhere when finished. You can enter a maximum of 32 characters in the edit box. You can also edit tree labels by double-clicking on the label.

*Edit **I**nputs* Basement wall, crawl space wall, and slab-on-grade assemblies display screens which illustrate dimensions being requested of the user. You may enter these dimensions directly into the illustration, then select the *OK* button to transfer them to the table on the *Envelope* screen. You may change any previously entered dimensions directly on the table, or you may use the *Edit **I**nputs* option to redisplay the illustration with the previously entered values. The *Edit **I**nputs* option can be selected by clicking the right mouse button on the tree label or table row of any basement wall, crawl space wall, or slab assembly. The option name in the context menu changes to *Edit Basement Inputs*, *Edit Crawl Inputs*, or *Edit Slab Inputs*, depending on the row being selected.

Compliance Example

The software approach is illustrated in this section. Assume that you plan to build the single-family house shown below on a lot located in Greensboro, North Carolina.



The following table lists the components that make up the building envelope, the area of these components, and the proposed insulation R-values and window and door U-factors. To determine compliance, you only need to input the areas, R-values, and U-factors listed in this table into the software, which will then display the compliance results in the *Compliance* field. If desired, you can then alter any or all of these inputs to determine if a revised design still complies with the code.

Determine Which Components Are Part of the Building Envelope

Only the building components that are part of the building envelope are considered for code compliance. Building envelope components are those that separate conditioned spaces (heated or cooled rooms) from outside air or from unconditioned spaces (rooms that are neither heated nor cooled). Walls, floors, and other building components separating two conditioned spaces are NOT part of the building envelope.

Building Component	Area	Insulation Level
Ceilings		
With Attic (Std. Truss)	729 ft^2	R-38
Vaulted	592 ft^2	R-30
Walls (2x4 @ 16-in. O.C.)		
Without Sheathing(a)	276 ft^2 (gross)	R-13
With Sheathing	1647 ft^2 (gross)	R-19 (R-13 cavity + R-6 sheathing)
Windows	204 ft^2	U-0.45
Doors		
Sliding Glass Doors	84 ft^2	U-0.61
Entrance	20 ft^2	U-0.54
Garage to Family Room	18 ft^2	U-0.35
Floors		
Over Garage	363 ft^2	R-19
Over Crawl Space	575 ft^2	R-19
Slab (Unheated)	82 ft^2 (perimeter)	R-8 (2-ft depth)
Bay Window Floor	32 ft^2	R-30
(a) Walls without sheathing are located between the family room and the garage, the laundry room and the crawl space, and the garage and the living room.		

Table 1. Example House Specifications

Walls In this example, the garage is unconditioned, so the exterior garage walls are not part of the building envelope. The wall between the conditioned family room and the unconditioned garage is part of the building envelope, including the wall of the stairwell facing the garage. Likewise, the wall between the garage and the living room is part of the building envelope.

Part of the laundry room wall separates the laundry room from the crawl space and the other part separates the laundry room from the kitchen. The wall portion adjacent to the crawl space is part of the building envelope because it separates the conditioned laundry from the unconditioned crawl space. The wall portion adjacent to the kitchen can be ignored because it separates two conditioned spaces. The wall portion adjacent to the family room can also be ignored. Likewise, the wall between the upstairs bathrooms and the kitchen and the wall between the center bedroom and the living room are not part of the building envelope. Portions of both of these walls are also adjacent to outside air, and those portions are part of the building envelope. The following table lists the walls that are part of the building envelope and indicates whether sheathing is installed on them (which is relevant when determining the R-value of the wall).

Wall	Sheathing?	Gross Area
All walls between interior conditioned space and outside air	Yes	1647
The wall between the family room and the garage	No	192
The wall between the garage and the living room	No	44
The wall between the laundry and the crawl space	No	40

Ceilings The dining room, living room, bay window roof, and entryway have a vaulted ceiling that will be insulated to R-30. The area covered by the vaulted ceiling totals 592 ft^2. The rest of the home has a ceiling with attic which will be insulated to R-38. Since these two ceiling areas will be insulated to different levels, they must be treated as two separate building components.

Floors The example house has a conditioned floor area of 1714 ft^2, but 378 ft^2 of the floor area is located over the family room and is not part of the building envelope (both the family room and the rooms above it are conditioned). The living room, dining room, and kitchen are over an unheated crawl space. The family room and garage both have slab-on-grade floors. The floor of the bay window is a floor over outside air.

Glazing and Doors There are two sliding glass doors in the building envelope – one leading from the dining room to the larger deck and one leading from the master bedroom to the smaller deck. There are two opaque doors in the building envelope – the front entry door and the door leading from the garage into the family room.

Enter the Location

On the *Project* folder, enter the location of the building and type of construction. Enter the city and state as Greensboro, North Carolina, and the construction type as single family.

Select the Code Year

This example is based on compliance with the 1995 MEC. Select the *1995 MEC* option from the ***C**ode* menu.

Create the Building Components List

Using the buttons at the top of the *Envelope* folder, create building components for the entries in Table 1. If you need more than one building component of the same type, you must enter each component separately. For example, you will need two different ceiling components since there are two different ceiling insulation R-values used in the example house. Select the *Ceiling* button and choose *All-Wood Joist/Rafter/Truss* from the list of ceiling types. This creates the first ceiling component. Repeat this step to create a second ceiling component. Create two 16" O.C. wood-framed wall components, one window component, three door components, two floor components (one *All-Wood Joist/Truss - Over Unconditioned Space* and one *All-Wood Joist/Truss - Over Outside Air*), and one unheated slab component with 2' depth of insulation. There are actually two *All-Wood Joist/Truss - Over Unconditioned Space* components in Table 1, but they are combined since they both have the same R-value (R-19).

After the building components have been created, fill in the areas, R-values, and U-factors from Table 1. The *Max. UA* field should show a total required UA of 466, and the field labeled *Your UA* should show a proposed UA of 415.

Save and Print a Report

Save the data you have entered by selecting the ***S**ave* option from the ***F**ile* menu. You will be asked to provide a name for the data file. Print a compliance report and/or inspection checklist by selecting the ***P**rint Report* option from the ***F**ile* menu. You can exit MEC*check* by selecting the *Exit* option from the ***F**ile* menu.

Check Your Work

An example file (EXAMPLE.CCK) has been included with the MEC*check* software. EXAMPLE.CCK is a data file which contains the same data used in this example. If you have any questions, the example file can be loaded into the software to show how the building used in this example should be entered into the software. To load this file, select the ***O**pen* option from the ***F**ile* menu.

Changing Location Files

The following text provides instructions for changing from the city version of the MEC*check* software to the county version.

The MEC*check* software contains three location files:

1. The CITIES file contains a list of cities for each state.
2. The COUNTIES file contains a list of counties for each state.
3. The LOCATION.MEC file is the file that is actually used by the software. By default, the LOCATION.MEC file is identical to the CITIES file. When you start the software you will be presented with a list of cities.

Changing to Counties

If you prefer to use the county version, copy the COUNTIES file into the LOCATION.MEC file.

Changing Back to Cities

To change back to the cities version, copy the CITIES file back into the LOCATION.MEC file.

Noteworthy:

If you have saved a data file for a building, the location for that building is also saved. If you subsequently change the LOCATION.MEC file as described above and try to load that data file back into the MEC*check* software, MEC*check* will not find the specified building location and will set the location to a default. Therefore, after loading the file into the program, you must go back to the *Project* screen and reselect your location.

Modifying the Cities or Counties

MEC and IECC code compliance is based on the heating degree-days based 65°F (HDD) of the location in which the building resides. This section describes how locations that are not currently available within MEC*check* can be added and how the HDD values for existing locations can be modified. You should not, however, modify the HDD value for any location without direction from your local jurisdiction. If locations are missing or incorrect for a given jurisdiction, we recommend that you contact the MEC*check* technical support staff and request a change be permanently made. Otherwise, any changes will be overwritten if newer versions

of MEC*check* are later installed. Technical support contact information is given on the splash screen that comes up when MEC*check* is first started.

MEC*check* accesses a list of cities or counties, depending on which version you are using. The cities are stored in a file named CITIES and the counties are stored in a file named COUNTIES. These files come with the MEC*check* software and should be located in the same directory as the MEC*check* executable file (MECCHECK.EXE).

The software uses a file named LOCATION.MEC, which will be identical to either the CITIES file or the COUNTIES file. The first line of the CITIES file contains the word **cities* and the first line of the COUNTIES file contains the word **counties*. This keyword tells the software whether cities or counties are currently contained in the LOCATION.MEC file, and should not be changed. The following text and illustration apply to the cities version. However, modifications can be made to the counties version in exactly the same manner.

The CITIES file begins with an alphabetical list of the states. The second line of the file contains an asterisk (*) followed by the word *states*. All asterisks are very important because they delineate the sections of the file.

The list of states is followed by lists of cities for each state. The cities for each state are listed separately, starting with the cities for Alabama. The Alabama cities start directly after the line reading **Alabama*.

Each city name is followed by fifteen climate values that apply to that city. The first value represents the heating degree-days base 65°F (HDD), and the second value represents the cooling degree-days base 65°F (CDD). Commas are used to separate the city name and climate values. Commas MAY NOT be used as part of a city name. Remove extra space on either side of all commas.

*cities
*states
Alabama
Alaska
Arizona
-
-
-

Wisconsin
Wyoming
*Alabama
Andalusia,2450,1944,10,1.29,0.95,1.078,65,7.09,4.79,10.47,19.78,1.061,0.76,1541,F
Anniston,2854,1787,3,1.00,0.96,1.058,62,7.09,4.79,10.47,19.78,1.060,0.69,1388,T
-
-
-

Union Springs,2481,2000,10,1.28,0.99,1.078,65,7.09,4.79,10.47,19.78,1.061,0.69,1388,F
Valley Head,4107,1118,3,1.29,0.81,1.058,62,7.09,4.79,10.47,19.78,1.060,0.64,1420,F
*Alaska
Adak,8881,0,21,1.34,1.00,1.306,40,3.52,6.48,12.21,33.84,0.604,1.16,268,F
Anchorage,10570,0,21,1.24,1.00,1.306,40,3.52,6.48,12.21,33.84,0.604,0.87,268,F
-
-
-

Wrangell,8056,14,21,1.00,1.00,1.306,40,3.52,6.48,12.21,33.84,0.604,0.94,1714,F
Yakutat,9485,0,21,1.00,1.00,1.306,40,3.52,6.48,12.21,33.84,0.604,0.95,268,F
*Arizona
-
-
-

etc.

If the CITIES or COUNTIES file is edited, care must be taken to save the new data in text (ASCII) format. To preserve this format, use a text editor, such as NOTEPAD. If a text processor such as Word Perfect or Microsoft Word is used, save the file as DOS text or ASCII text. Copy the edited file to LOCATION.MEC.

To Add, Delete, or Modify Cities

1. Find the list of cities you wish to modify.
2. Add, delete, or modify as many city lines as you wish. Each new line must adhere to the format described above. To add a new city, find the city in the file closest in location and weather to the city you want to add. Copy the existing city line to the correct alphabetical location for the new city. Change the city name to the new city name. You may modify the HDD and/or CDD values to match the new city values, if known. Do not modify any of the other climate data.

To Delete an Entire State

1. Delete the state name from the list of states located at the beginning of the file.
2. Delete the list of cities corresponding to that state. Be sure to delete all cities AND the name of the state which precedes them.

Appendix A: Additions

1992 MEC, 1993 MEC, and 1995 MEC

What is an Addition?

Additions to existing buildings must comply with code requirements when the addition is within the scope of the code and would not otherwise be exempted. Although not specifically defined in the code, building codes typically define an addition as any increase in a building's habitable floor area (which can be interpreted as any increase in the conditioned floor area).

Additions include new construction, such as a conditioned bedroom, sunspace, or enclosed porch added to an existing building. Additions also include existing spaces converted from unconditioned or exempt spaces to conditioned spaces.

For example, a finished basement, an attic converted to a bedroom, and a carport converted to a den, are additions. An unconditioned garage converted to a bedroom is an addition, but the addition of an unconditioned garage would not be considered within the scope of the code, since the code applies to heated or cooled (conditioned) spaces. If a conditioned floor area is expanded, such as a room made larger by moving out a wall, only the newly conditioned space must meet the code. A flat window added to a room does not increase the conditioned space and thus is not an addition by this definition.
Compliance Options for Additions

The addition (the newly conditioned floor space) complies with the code if it complies with all of the applicable code requirements. For example, requirements applicable to the addition of a new room would most likely include insulating the exterior walls, ceiling, and floor to the levels specified in the code; sealing all joints and penetrations; installing a vapor retarder in unventilated framed walls, floors, and ceilings; identifying installed insulation R-values and window U-factors; and insulating and sealing any ducts in unconditioned portions or exterior components (walls, ceilings, or floors) of the new space.

There are three approaches by which an addition can comply with the code:

- The addition as defined above meets all code requirements. This approach does not require that the original portion of the building meet code requirements.
- If the building with the addition complies with the code, the addition will also comply, regardless of whether the addition complies alone. For example, a sunroom that does not comply with the code is added to a house. If the entire house (with the sunroom) complies, the addition also complies.

- The addition, including possible concurrent renovation, does not increase the whole building UA or energy use. The change in UA or energy use can be shown by any of the commonly used code compliance tools. For example, additions that add rooms while simultaneously upgrading the existing HVAC system, windows, and/or insulation often reduce the energy use or UA of the existing part of the home, more than offsetting the added space to the home.

Appendix B: Default U-Factors

1992 MEC, 1993 MEC, and 1995 MEC

Glazing and Door Defaults

The following tables provide default U-factors for glazing and doors based on the glazing or door features. The U-factors in these tables can be used in the absence of NFRC-labeled values.

Glazing and doors cannot receive credit for features that cannot be clearly detected, such as argon gas fills and low-emissivity (low-E) coatings. Windows with these features may achieve much lower U-factors than those listed in Table 1. For example, a double-pane wood or vinyl window with low-E glass may have a U-factor around 0.38. The same window with argon gas may be rated at 0.34. Therefore, it may be advantageous to use tested, documented, and labeled U-factors for these types of windows.

Where a composite of materials from two different product types is used, the window or door must be assigned the higher U-factor.

Table 1. U-Factors for Windows, Glazed Doors, and Skylights

Frame/Glazing Features	Single Pane	Double Pane
Metal Without Thermal Break		
Operable	1.30	0.87
Fixed	1.17	0.69
Door	1.26	0.80
Skylight	2.02	1.30
Metal With Thermal Break		
Operable	1.07	0.67
Fixed	1.11	0.63
Door	1.10	0.66
Skylight	1.93	1.13
Metal-Clad Wood		
Operable	0.98	0.60
Fixed	1.05	0.58
Door	0.99	0.57
Skylight	1.50	0.88
Wood/Vinyl		
Operable	0.94	0.56
Fixed	1.04	0.57
Door	0.98	0.56
Skylight	1.47	0.85
Glass Block Assemblies	0.60	

Table 2. U-Factors for Non-Glazed Doors

Steel Doors		
Without Foam Core	0.60	
With Foam Core	0.35	
Wood Doors	**Without Storm**	**With Storm**
Panel With 7/16-in. Panels	0.54	0.36
Hollow Core Flush	0.46	0.32
Panel With 1 1/8-in. Panels	0.39	0.28
Solid Core Flush	0.40	0.26

Appendix C: Building Envelope

1992 MEC, 1993 MEC, and 1995 MEC

What Is The Building Envelope?

The code requirements are intended to limit heat loss and air leakage through the building envelope. The building envelope includes all of the building components that separate conditioned spaces from unconditioned spaces or from outside air. For example, the walls and doors between an unheated garage and a living area are part of the building envelope; the walls separating an unheated garage from the outside are not. Walls, floors, and other building components separating two conditioned spaces (such as an interior partition wall) are *NOT* part of the building envelope, nor are common or party walls which separate dwelling units in multifamily buildings.

You can think of the building envelope as the boundary separating the inside from the outside and through which heat is transferred. Areas that have no heating or cooling sources are considered to be outside the building envelope. A space is conditioned if heating and/or cooling is deliberately supplied to it or is indirectly supplied through uninsulated surfaces of water or heating equipment or through uninsulated ducts.

To use the MEC*check* materials, you must specify proposed insulation levels for ceiling, wall, floor, basement wall, slab-edge, and crawl space wall components located in the building envelope. In some case it may be unclear how to classify a given building element. For example, are skylight shafts considered a wall component or a ceiling component? The following table can be used to help determine how a given building envelope assembly should be entered in the MEC*check* materials.

Ceiling Components

Ceiling	Flat ceilings Cathedral or vaulted ceilings Dormer roofs Bay window roofs Overhead portions of an interior stairway to an attic Access doors or hatches Treyed ceilings
Floors Over Outside Air(a)	Floors of overhangs (such as the floor above a recessed entryway or carport) Floor cantilevers Floors of an elevated home Bay window sill Access doors or hatches
Skylights	Skylight assemblies less than 60° from horizontal
(a) The insulation requirements for floors over outside air are the same as those for ceilings.	

Wall Components

Wall	Opaque portions of above-grade walls Basement walls and kneewalls less than 50% below grade Peripheral edges of floors Between floor spandrels Gables walls bounding conditioned space Dormer walls Walls enclosing a mansard roof Roof or attic kneewalls Through-wall chimneys Walls of an interior stairway to an unconditioned basement Skylight shafts Sloped building components 60° or greater from horizontal
Glazing	Windows (including windows of conditioned basements)
Door	Opaque portions of all doors (including basement doors)

Floor and Foundation Components

Floor Over Unconditioned Space	Floors over an unconditioned crawl space, basement, garage, or similar unconditioned space Access doors or hatches
Basement Wall	Opaque portions of basement walls 50% or more below grade and basement kneewalls (if part of a basement wall 50% or more below grade)
Slab Floor	Perimeter edges of slab-on-grade floors
Crawl Space Wall	Walls of unventilated crawl spaces below uninsulated floors

Appendix D: Forms

1992 MEC, 1993 MEC, and 1995 MEC

Energy Label and Take-Off Worksheet

The following forms are included in this Appendix:

- *Energy Label* – Describes the energy efficiency features installed in the residence. This label is optional. It may be posted at the building site or provided to the home buyer.
- *Take-Off Worksheet* – Provides a form for building take-offs.

Energy Label

MECcheck

Street Address _____

This home includes the following energy features:

Insulation R-Values

Insulating Sheathing	R-Value	
_____	_____	Ceiling
_____	_____	Ceiling
_____	_____	Wall
_____	_____	Wall
	_____	Floor
	_____	Basement Wall
	_____	Crawl Space Wall
	_____	Slab
	_____	Duct

Glazing/Door U-Factors

U-Factor	
_____	Windows
_____	Windows
_____	Sliding Glass Doors
_____	Doors
_____	Doors

Mechanical System	Type and Fuel	Efficiency
Heating System	_____	_____
Cooling System	_____	_____ SEER
Water Heater	_____	_____ EF

Other Energy Features

_____

_____

_____

_____

Builder _____ Date _____

Version 3.0; April 2000
U.S. Dept. of Housing and Urban Development / Rural Economic and Community Development
U.S. Dept. of Energy / Pacific Northwest National Laboratory

Take-Off Worksheet

Builder Name _____ Date _____

Builder Address _____

Building Address _____

Submitted By _____ Phone Number _____

Ceilings, Skylights, and Floors Over Outside Air

Description	Area	Insulation R-Value	Skylight U-Factor
Ceiling	ft^2		—
Floor Over Outside Air	ft^2		—
Skyulight	ft^2	—	

Walls, Windows, and Doors

Description	Area	Insulation R-Value	Glazing/Door U-Factor
Wall	ft^2		—
Window	ft^2	—	
Door	ft^2	—	
Sliding Glass Door	ft^2	—	

Floors and Foundations

Description	Area or Perimeter	Insulation R-Value	Insulation Depth
Floor Over Unconditioned Space	ft^2		—
Basement Wall	ft^2		
Unheated Slab	ft		
Heated Slab	ft		
Crawl Space Wall	ft^2		

Equipment Efficiency (This section may be left blank if no credit will be taken for high-efficiency equipment.)

Heating _____ AFUE/HSPF _____

Cooling _____ SEER _____

Efficiency Make & Model Number

Definitions

MEC*check* Terms

Addition(s)

An extension or increase in the height, conditioned floor area, or conditioned volume of a building. The code applies to additions of existing buildings.

Alteration

Any construction renovation, or change in a mechanical system that involves an extension, addition, or change to the arrangement, type, or purpose of the original installation.

AFUE

Annual fuel utilization efficiency; combustion heating equipment efficiency is expressed in terms of AFUE. New equipment typically ranges from about 78- to 96-percent AFUE. Higher AFUE ratings indicate more efficient equipment.

Basement Wall(s)

1992, 1993 – Basement walls that enclose conditioned spaces are part of the building envelope. Basement wall refers to the opaque portion of the wall (excluding windows and doors). To be considered a basement wall, at least 50% of the total wall area (including openings) must be below grade. For walls less than 50% below grade, include the entire opaque wall area as part of the above-grade wall.

1995 – Basement walls that enclose conditioned spaces are part of the building envelope. Basement wall refers to the opaque portion of the wall (excluding windows and doors). To be considered a basement wall, at least 50% of the wall's total wall area (including openings) must be below grade. Treat walls on each side of the basement individually when determining if they are above grade or basement walls. For any individual wall less than 50% below grade, indicate the entire opaque wall area of that individual wall as part of the above-grade walls.

BOCA

Building Officials and Code Administrators International, Inc.

Building Envelope

All components of a building that enclose conditioned space. Building envelope components separate conditioned spaces from unconditioned spaces or from outside air (see conditioned space). For example, walls and doors between an unheated garage and a living area are part of the building envelope; walls separating an unheated garage from

the outside are not. Although floors of conditioned basements and conditioned crawl spaces are technically part of the building envelope, the code does not specify insulation requirements for these components and they can be ignored.

Ceiling(s)

The ceiling requirements apply to portions of the roof and/or ceiling through which heat flows. Ceiling components include the interior surface of flat ceilings below attics, the interior surface of cathedral or vaulted ceilings, skylights, or vaulted ceilings, skylights and sloped building assemblies less than 60° from horizontal, but excluding skylight shafts. Refer to Building Envelope Components in Appendix C for a comprehensive list of ceiling components.

Conditioned

See Conditioned Space

Conditioned Space

A space is conditioned if heating and/or cooling is deliberately supplied to it or is indirectly supplied through uninsulated surfaces of water or heating equipment or through uninsulated ducts. For example, a basement with registers or heating devices designed to supply heat is conditioned. An indirectly heated basement is also conditioned if the basement ceiling is not insulated and heat is indirectly supplied to the space, such as through uninsulated ducts or through uninsulated surfaces of water heaters or space heating equipment.

Cooled

A space within a building which is provided with a positive cooling supply.

Crawl Space

The MECcheck crawl space wall insulation requirements are for the exterior walls of unventilated crawl spaces (i.e. not directly vented to the outside) below uninsulated floors. A crawl space wall component includes the opaque portion of a wall that encloses a crawl space and is partially or totally below grade, as measured from the sill to the top of the footing.

Crawl Space Wall(s)

The opaque portion of a wall which encloses a crawl space and is partially or totally below grade.

Door

Doors include all openable opaque assemblies located in exterior walls of the building envelope. Doors with glass can be treated as a single door assembly, in which case an aggregate U-factor (a U-factor that includes both the glass and the opaque area) must be used; OR the glass area of the door can be included with the other glazing and an opaque door U-factor can be used to determine compliance of the door.

Dwelling Unit

A single housekeeping unit of one or more rooms providing complete, independent living facilities, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Equipment Efficiency(ies)

The measure of equipment efficiency varies with equipment type. Combustion heating equipment efficiency is expressed in terms of AFUE. New equipment typically ranges from about 78- to 96-percent AFUE. Cooling efficiency for electric air conditioners and heat pumps is expressed in terms of SEER. New equipment ranges from 10 to about 16 SEER. Heat pump heating is expressed in terms of HSPF. New equipment ranges from

about 6.8 to 10.0 HSPF. Higher AFUE, SEER, and HSPF ratings indicate more efficient equipment.

Glazing

Any translucent or transparent material in exterior openings of buildings, including windows, skylights, sliding doors, the glass area of opaque doors, and glass block.

Glazing Area

The area of a glazing assembly is the interior surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. The nominal area or rough opening is also acceptable for flat windows and doors.

Gross Wall Area

1992, 1993 – The gross wall area includes the opaque area of above-grade walls, the opaque area of walls of conditioned basements less than 50% below grade (including the below-grade portions), all windows and doors (including the windows and doors of conditioned basements), and the peripheral edges of floors.

1995 – The gross wall area includes the opaque area of above-grade walls, the opaque area of any individual wall of a conditioned basement less than 50% below grade (including the below-grade portions), all windows and doors (including windows and doors of conditioned basements), and the peripheral edges of floors.

Heated

A space within a building which is provided with a positive heat supply.

Heating Degree Days

A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C), there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F (18°C).

HSPF

Heating seasonal performance factor; heat pump heating is expressed in terms of HSPF. New equipment ranges from about 6.8 to 10.0 HSPF. Higher HSPF ratings indicate more efficient equipment.

HUD

The U.S. Department of Housing and Urban Development

ICBO

The International Conference of Building Officials

ICC

The International Code Council

IECC

The International Energy Conservation Code; formerly known as the MEC

MEC

The Model Energy Code

Multifamily

A multifamily building is a residential building three stories or less in height that contains three or more attached dwelling units. Multifamily buildings include apartments,

condominiums, townhouses, and rowhouses. Hotels and motels are considered commercial rather than residential buildings.

NAECA

The National Appliance Energy Conservation Act of 1987, 42 USC 6291 et seq., as amended, Public Law 100-12.

Net Wall Area

The net wall area includes the opaque wall area of all above-grade walls enclosing conditioned spaces, the opaque area of conditioned basement walls less than 50% below grade (including the below-grade portions), and peripheral edges of floors. The net wall area does not include windows, doors, or other such openings, as they are treated separately.

NFRC

National Fenestration Rating Council

Opaque Areas

Opaque areas referenced in this guide include all areas of the building envelope except openings for windows, skylights, doors, and building service systems. For example, although solid wood and metal doors are opaque, they should not be included as part of the opaque wall area (also referred to as the net wall area).

Repair

A repair includes the reconstruction or renewal of any part of an existing building for maintenance purposes.

Raised Truss

Raised truss refers to any roof/ceiling construction that allows the insulation to achieve its full thickness over the plate line of exterior walls. Several constructions allow for this, including elevating the heel (sometimes referred to as an energy truss, raised-heel truss, or Arkansas truss), use of cantilevered or oversized trusses, lowering the ceiling joists, or framing with a raised rafter plate.

RECD

The Rural Economic and Community Development, formerly the Farmer's Home Administration.

Residences

See Residential Buildings

Residential Buildings

For the purposes of the code, Group R residential buildings include:

- Type A-1 – Detached one- and two-family dwellings; and
- Type A-2 – All other residential buildings, three stories or less in height

R-Value

A measure (h ft^2 °F/Btu) of thermal resistance, or how well a material or series of materials resists the flow of heat. R-value is the reciprocal of U-factor.

$$\text{R-Value} = \frac{1}{\text{U-Factor}}$$

SBCCI

The Southern Building Code Congress International, Inc.

SEER

Seasonal energy efficiency ratio; cooling efficiency for electric air conditioners and heat pumps is expressed in terms of SEER. New equipment ranges from about 10 to 16 SEER. Higher SEER ratings indicate more efficient equipment.

Single Family

A detached one- and two-family residential building, irrespective of height.

Skylight

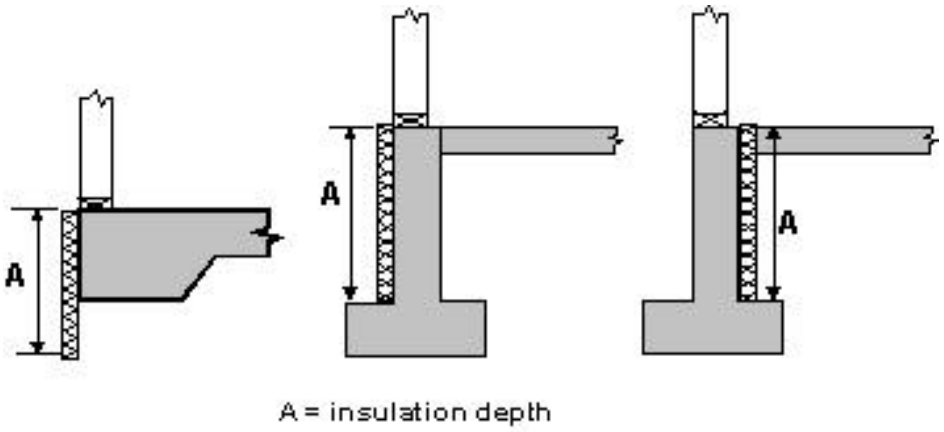
Glazing that is horizontal or sloped at an angle less than 60° (1.1 rad) from horizontal.

Slab Edge

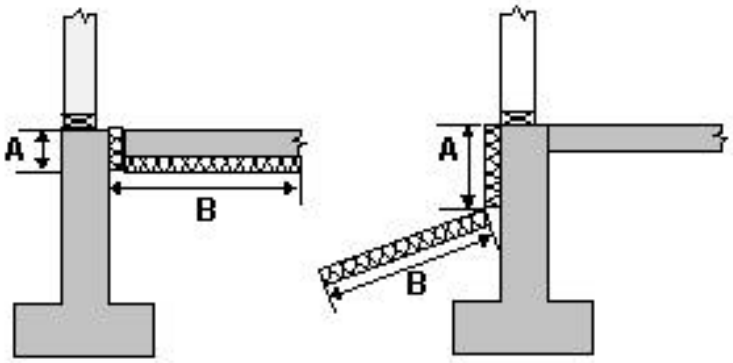
Slab edge refers to the perimeter of a slab-on-grade floor, where the top edge of the slab floor is above the finished grade or 12 in. or less below the finished grade. The slab perimeter should include the length of all edges of a slab foundation that are part of the building envelope and are less than 12 in. below grade (i.e. all edges separating conditioned space from unconditioned space).

The insulation can be installed using any of the following configurations, but in all cases it must start at the top of the slab:

- The slab insulation extends from the top of the slab downward to the required depth.
- The slab insulation extends from the top of the slab downward to the bottom of the slab and then horizontally underneath the slab for a minimum total linear distance equal to or greater than the required length.
- The slab insulation extends from the top of the slab downward to the bottom of the slab and then horizontally away from the slab for a minimum total linear distance equal to or greater than the required depth. The horizontal insulation must be covered by pavement or at least 10 in. of soil.



A = insulation depth



A + B = insulation depth

The top edge of insulation installed between the exterior wall and the interior slab can be cut at a 45° angle away from the exterior wall.

Slab-On-Grade Floor

A floor that is poured in direct contact with the earth.

Unconditioned

An enclosed space within a building that is not a conditioned space.

U-Factor

A measure (Btu/h ft^2 °F) of how well a material or series of materials conducts heat. U-factors for window and door assemblies are the reciprocal of the assembly R-value.

$$\text{U - Factor} = \frac{1}{\text{R - Value}}$$